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FOOD PRODUCTS

THEIR

SOURCE, CHEMISTRY, AND USE

BAILEY

FOOD PRODUCTS

THEIR
SOURCE, CHEMISTRY, AND USE

BY

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APPLIED CHEMISTRY," ETC.

SECOND REVISED EDITION

WITH 92 ILLUSTRATIONS

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PREFACE TO THE SECOND EDITION

On account of the numerous changes that have recently taken place in the Food Supply of the world, especially on account of the world war, and because of the new food products that have been put upon the market and the by-products that have been utilized as human food, a second edition of this book seemed to be demanded.

The curtailment of brewing and distilling in the United States, on account of the passage of the 18th. amendment to the Federal Constitution, has made the manufacture of alcohol and alcoholic liquors of much less importance than formerly, therefore the sections devoted to these topics have been considerably condensed.

The Chapters on Animal and Vegetable Fats and Oils, on Nuts, Cereals and Cereal products have been revised and some new matter has been introduced. The statistics of production and use of foods have, wherever possible, been brought down to 1919. Other changes and corrections necessary to the bringing of our knowledge of Food Products down to the present time, have been made throughout. Numerous illustrations have been added. For assistance in correcting the proof, and for many valuable suggestions, the author is greatly indebted to Mr. Herbert S. Bailey of Savannah, Ga.

52867

PREFACE TO THE FIRST EDITION

In recent years the facts concerning the source, composition and use of the different food products are becoming more generally known, and contributions to this subject are more widely appreciated than formerly. Although the writer fully realizes the immense field covered by the title "Food Products," nevertheless he has made the attempt to bring together in one volume of convenient size the more important facts in regard to that which we eat and drink. These facts are distributed through a multitude of books, pamphlets and scientific reports, which are not readily accessible to the general public.

No attempt is made to give sufficient details in regard to farming to make a successful farmer, in regard to manufacturing food products to make an expert in this line, nor to give specific directions to the person who prepares the food for the table—all these topics are treated in special books with which the market is already filled. The general principles of food production, manufacture and preparation are, however, discussed in such a way that the reader may have a practical knowledge as to what constitutes a good food, and where it is obtained. It is only by knowing what good, wholesome food is, its composition and appearance, that we can hope for an improvement in the general food supply. When this knowledge is widely disseminated, public opinion will go far toward correcting any abuses that still exist in the food market; for pure food laws are but the crystallized sentiment of the united protest of the people against unwholesome and fraudulent products.

It is believed that this book will be found sufficiently complete to serve as a text for students of foods in our Colleges and Hi Schools, and to properly supplement and give more completen

e ordinary courses in "Preparation of Food," "Selection
conomic Use of Food" and "Dietetics."

he plan followed in treating of the important foods and bever-
ound in the markets of the world, is to discuss their source,
ods of preparation for the market, how they are packed,
rved and shipped, their composition and nutrient and die-
value, and their use by people of different countries.

ecial attention is called to the arrangement of the several
, which while somewhat different, it is believed will be found
logical than that ordinarily adopted. After discussing the
points of importance under each heading, the by-products,
oods and beverages which are directly or indirectly made
this material, are considered. Thus, following cane sugar
lucose, confectionery is discussed; after grapes comes the
leration of grape juice, wine, and finally brandy—each in its
priate place.

ustrations are used where they will add clearness to the
or where they will bring into prominence certain methods
duction, manufacture or distribution of foods.

Isabel Bevier of Urbana, Ill., and Mr. C. S. McFarland of Burnside, La. Permission to copy illustrations has been duly acknowledged elsewhere, but special thanks are due to Mr. Jos. A. Arnold of the U. S. Department of Agriculture, the Central Scientific Co. of Chicago, and Mr. L. S. Bushnell of Kansas City, for courtesies extended.

E. H. S. BAILEY.

LAWRENCE, KAS.

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FOOD PRODUCTS

CHAPTER I

THE SOURCE AND COMPOSITION OF FOOD

To supply himself with food which shall build up the tissues of the body, and yield energy for daily work, has always been one of the most important problems which man has to solve. This outranks in importance even the question of clothing and shelter, for, among primitive peoples especially, much less time and labor are bestowed on these necessities than on how to get enough to eat. In the earlier times each family provided itself with food from the immediate vicinity of its dwelling; but as the conditions of society became more complicated, and great centers of population grew up, it was no longer possible to supply the people with food in this way, and it became necessary to depend on the labor of others to procure the food and bring it to our door. The business of supplying the world with food has gradually increased until to-day an immense number of laborers is employed in raising, manufacturing and distributing the food products of the world. This fact is illustrated, as far as the producers and manufacturers are concerned, by the following table:

THE MOST IMPORTANT FOOD PRODUCERS AND MANUFACTURERS ARE AS FOLLOWS, FOR

1. **Cereal Foods.**
    - a. Farmers.
    - b. Millers of wheat, rye, corn, oats rice, and barley.
    - c. Bakers of bread, crackers, cakes, pastry and pretzels.
    - d. Manufacturers of macaroni, vermicelli and food pastes.
    - e. Manufacturers of prepared "cereals," breakfast foods, proprietary and infant's foods.

Manufacturers of starches, yeast, baking powder, cream of tartar, baking soda, calcium phosphate, alum, aluminum sulfate and common salt.
Manufacturers of cereal by-products, as corn oil and oil cake.

gars.

Planters.
Sugar manufacturers, from cane, beets, maple sap and sorghum.
Glucose manufacturers, from corn, rice or wheat starch.
Sirup manufacturers.
Honey growers.
Candy and confectionery manufacturers.
Manufacturers of Maltose and similar sugars from malted grains.

uits and Vegetables.

Farmers, gardeners and horticulturalists.
Canners, packers and dryers of fruits and vegetables.
Manufacturers of jams, jellies, preserves, etc.
Manufacturers of pickles, and of vinegar, mustard and similar condimental products.
Manufacturers of Citrus and other by-products from fruits and vegetables.

ts and Oils from Nuts and Fruits.

Farmers and growers of nuts and oil-bearing fruits.
Manufacturers of peanut butter, nut foods and vegetable oils.
Manufacturers of butter and lard substitutes.

8. **Spices.**
    a. Growers of spices.
    b. Millers and manufacturers of spices and condiments.
    c. Manufacturers of essential oils.
9. **Ice and Cold Storage.**
    a. Manufacturers and storers of natural and artificial ice.
    b. Proprietors of cold storage plants and refrigerator cars and vessels.
10. **Non-intoxicating Beverages.**
    a. Tea, coffee, cocoa and chocolate growers, roasters and grinders.
    b. Manufacturers of pop, soda water, lemonade and iced drinks.
    c. Manufacturers of carbon dioxide gas for carbonating beverages.
    d. Bottlers of natural and artificial mineral waters.
    e. Manufacturers of ethers, esters and synthetic flavors.
    f. Manufacturers of "dealcoholized" or "near-beers," grape juice, bottled cider, etc.
11. **Intoxicating Beverages.**
    a. Manufacturers of malt, ale, beer, stout, porter, etc.
    b. Manufacturers of wine, cider and perry.
    c. Distillers and rectifiers of alcohol, rum, gin, brandy and whiskey.
    d. Manufacturers of cordials, liqueurs, etc.
12. **Water.**
    a. Proprietors of plants for the storage, filtration and distribution of water.
    b. Manufacturers and distributors of distilled and table waters.

Perishable and Non-perishable Foods

The food made available by this immense number of producers may be classified into perishable and non-perishable products. It fortunately happens that many of the staple products, like the cereals, keep for a series of years, and bear transportation to any part of the globe. There are, however, more food-stuffs that are of such a perishable nature that the greatest care must be exercised in keeping them long enough to transport them to a distant market. There are some, in fact, especially foreign and tropical fruits and vegetables, that are so perishable that they are seldom known outside the limited area in which they are grown. In general it may be said that the products of northern climates bear transportation better than tropical fruits and vegetables, although there are some exceptions to this rule. The animal products are of course all quite perishable, but under modern methods of sportation there is nothing to prevent their use in the countries ne opposite side of the globe from that in which they are prod. The importation of food-stuffs into the United States has y doubled within the last twenty years. This increase is ially noticeable in the case of tea, coffee, cocoa, and tropical s. The importation of fruits and nuts is increasing at the rate ,000,000 a year, while the quantity of meats and animal prod- such as cheese, that are brought into the United States, is times as much as it was a few years ago.

Distribution of Food

i the early settlement of a country and among primitive les the food produced was distributed largely by the producers

marketmen or farmers who bring in the produce. It frequently happens, however, that the farmers expose their produce for sale in the public market square, without any buildings, except such as they temporarily erect. (Fig. 1.) This method of supply is common throughout the Old World, and to some extent in the larger cities in the United States.

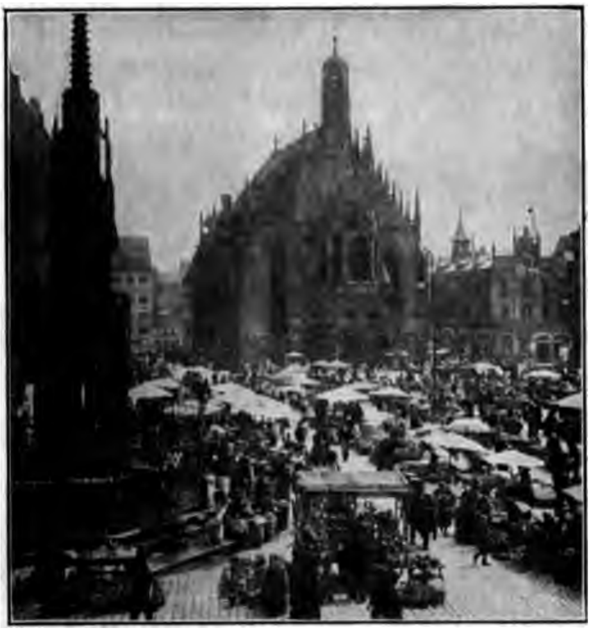

Fig. 2.—Market Place and Cathedral, Nuremberg, Ger. (Copyright, Keystone View Co.)

From some of the great food markets of the world, as Smithfield, Covent Garden and Billingsgate in London, the Halles Centralies in Paris, Washington and Fulton market in New York, and from the produce dealers in the vicinity, millions of people are *daily* supplied with food. (Fig. 2.) In many Latin American cities the market is a very primitive affair. The market-women are screened from the intense heat of the sun only by the most temporary kind of shelters. (Fig. 3.) Without these daily ties the food supply of the people would immediately fail amine be imminent. The slight blocking of transportation me disaster, a storm, or a strike would immediately cause ice of food to rise, because the supply is cut off.

second method of local distribution of food is by the licensed rs, especially in the larger cities, who procure the food at the t or of wholesale dealers, and peddle it from house to house. method, which is perhaps even more common in the older of Europe than in the United States, is extended into the nding country by itinerant peddlars. One advantage

in taking orders, for the numerous delivery men and wagons that from each grocery supply families in different and often distant parts of the city, and unless the grocery be run on a cash basis, the paying consumer helps to bear the losses incurred from trusting those who never pay.

Two modifications of this latter method of distribution have been recently introduced; the "Cash and Carry" stores, where a discount is allowed, since the expense of delivery is eliminated, and the so-called "Piggley Wiggely" stores, in which the customer helps himself, as in the modern Cafeteria, and thus the expense of many clerks is eliminated.

Sources of Food

All the food of man comes originally from the soil, the air and the water. There are however many transformations before the mineral salts, the oxygen, carbon dioxide, and nitrogen of the air, and the hydrogen and oxygen of the water, are changed to the highly organized bodies which constitute our foods, but these changes are unceasingly worked out day by day in the laboratories of the plant and animal organisms. Plants are the great builders of foods; animals utilize and modify the materials thus built up, yielding in their flesh a portion of the food they consume. Vegetable food is a less highly organized and less concentrated form of nourishment than that from animal sources, and most animals that are used as food by man feed on vegetable foods.

The most primitive people of whom we have any knowledge, not only used the wild animals caught in the chase, the fish, and the wild fruits and berries for food, but they very early began to domesticate the animals and to cultivate the grains and fruits, so as to be less dependent on what they might chance to find provided by the hand of nature. There is no evidence that these early peoples were vegetarians, for the adaptability of the human body to the use of animal foods and the earliest history disprove this; indeed some of the most uncivilized peoples of the present day subsist almost exclusively on fish and game.

FOOD CONSTITUENTS

rom a study the composition of foods, it is evident that lementary substances of which they are composed are n number, and that the highly complex food materials in the able and animal kingdoms are built up from a few simple ances combined in innumerable ways. These elements or e substances of the foods, which subsequently become a of the animal body, are carbon, the central element of all ic nature, hydrogen, one of the two constituents of water, n which occurs free in the air and combined in water, and gen, which is also free in the air and the characteristic element imal tissues. These are the most abundant, but in addition ese and equally necessary in the development of plants and ls are sulfur, phosphorus, chlorin, fluorin, silicon, calcium, sium, sodium, magnesium, iron, manganese, and copper— n in all.

ist as it is possible for the architect to erect an infinite y of buildings from a few simple building materials, so in the necessary to the growth of all vegetable and animal tissue. The occurrence and properties of water, and its relation to the foods in common use, are discussed elsewhere.

The organic substances of the food may be classified as follows, viz.: carbohydrates, fats, organic acids and nitrogenous compounds.

The **carbohydrates** are among the chief products of plant life. Some of them, like cane and grape sugar, are crystalline and soluble in water; while others, like starch and cellulose, are insoluble in water and have no crystalline structure. Most of these substances contain hydrogen and oxygen in the proportions to form water thus, H_2O, therefore the term "carbohydrate." The more compex of these bodies are readily broken up by acids or ferments into some of the simpler bodies.

Fats consist of the glyceryl esters of the fatty acids and nearly always contain about one per cent. of unsaponifiable substances. The fats readily saponify with alkalies to form soaps. (See p. 307.)

The **nitrogenous** compounds or proteins are of a very complex structure, and occur in both vegetable and animal tissues. (See p. 19.)

I. Carbohydrates

1. *The cellulose or polysaccharid group* $(C_6H_{10}O_5)_n$.
    - a. Cellulose.
    - b. Starch, inulin, lichenin.
    - c. Glycogen.
    - d. Dextrin.
    - e. Malto-dextrin.
    - f. Gum (arabin, bassorin, cerasin).
2. *The cane sugar or disaccharid group* $(C_{12}H_{22}O_{11})$.
    - a. Cane sugar (sucrose).
    - b. Malt sugar (maltose).
    - c. Milk sugar (lactose).

The glucose or monosaccharid group ($C_6H_{12}O_6$).
  a. Glucose (grape sugar or dextrose).
  b. Fructose (fruit sugar or levulose).
  c. Galactose.
  d. Mannose.
  e. Sorbinose.

The pectose group.
  a. Pectin.
  b. Pectosic acid.
  c. Pectic acid.

II. Fats

Animal.
  a. Hard (tallow, suet).
  b. Soft or liquid (milk fat, fish oils).

Vegetable.
  a. Oils.
  b. Butters (cacao, cocoanut).
  c. Artificially hardened (Crisco). (Snow Drift.)

CARBOHYDRATES

The carbohydrates are found in various vegetable substances, and are of exceedingly varied structure and composition. They are all composed however, essentially, of oxygen, hydrogen and carbon, but so combined as to make a very complicated molecule. In some cases we know how the different parts of the molecule are related, and in others, although we know the percentage composition, it is not possible with our present knowledge to determine the molecular weight, or, as we sometimes say, to know how many atoms go to make up the molecule.

The carbohydrates are among the best known and the most important foods, both for man and the lower animals. They are the most important nutrients in cereals, roots, stalks, fruits and seeds. Although the full mechanism of the building up of carbohydrates in plants is not understood, we know that through the energy of the sun's rays acting on the chlorophyl, carbon dioxide and water, which contain the bulk of the elements needed, unite to form these organic compounds. Some nitrogenous substances and the mineral constituents are drawn from the soil. The volume of oxygen liberated is equal to the volume of carbon dioxide which disappears.[1] The "net" results of the process may be represented thus:

$$6CO_2+6H_2O=C_6H_{12}O_6+6O_2$$

It is probable that formaldehyde is an intermediate product, and hydrogen peroxide is produced, as shown thus:

$$CO_2+3H_2O=CH_2O+2H_2O_2.$$

Under the influence of sunlight in the chlorophyl cell the hydrogen peroxide is rapidly decomposed into water and oxygen, and the formaldehyde built up into a carbohydrate. Glucose appears as a direct polymer of formaldehyde thus:

(Formaldehyde) $CH_2O \times 6$ equals $C_6H_{12}O_6$ (glucose).

---

[1] Chemistry of Food and Nutrition, Sherman, p. 4.

POLYSACCHARIDS

ulose $(C_6H_{10}O_5)_n$, a carbohydrate of very complex charac- the predominating constituent of vegetable tissues. This, water, is the most abundant substance in the vegetable m, forming as it does the basis of wood, cotton, linen and fibrous bodies. Absorbent cotton and "washed" filter are examples of almost pure cellulose. A peculiarity listinguishes cellulose from most other vegetable substances isolubility in ordinary liquids, such as hot and cold water, , ether or dilute acids and alkalies. To be appreciably d cellulose must be heated with acids or alkalies, an am- al solution of cupric oxide, or other strong chemicals.

cellulose is the substance from which the framework of the s built,[1] it gives rigidity to certain parts, and if these are used as food, the greater the proportion of cellulose ed the more difficult will be their digestion. There is more e in the older parts of the plant, as the stem, than in the

While the plant is young, some of the cellulose is in chemical combination with water, forming hydrated cellulose, a portion of which undergoes digestion, and produces heat and energy in the body.[1]

If food rich in cellulose is very finely ground it is more readily acted upon by the digestive fluids. "Wood flour" was mixed with certain foods in Germany during the War, for the purpose of making the meager rations go farther.

Some of the lower animals, as the rodents, can no doubt digest cellulose quite readily, but it apparently adds very little to the nutritive value of the food of man. Whatever digestion of cellulose does take place, in the intestines says Lohrisch,[2] seems to be due to the action of certain microörganisms by which fatty acids are produced, which upon absorption yield nutrients.

As will be seen in the later discussion of the various foods, whatever may be said of the lack of nutritive value of cellulose, it is of value mechanically, as it dilutes and gives more bulk to those foods which are rich in starch, sugar and protein. The eating of bulky vegetable foods, low in nutritive value, may however be carried too far, as their constituents are mainly digested in the intestines, where they are liable to ferment and produce gases which will cause the distention of the intestinal organs. In this way the use of an exclusively vegetarian diet may lead to unpleasant results.

Starch $(C_6H_{10}O_5)_n$ is the form in which the digestible carbohydrates are finally stored in the plants after they have circulated through the ducts and cells as the more soluble sugars. The food plants contain it, frequently to the extent of 60 or 70 per cent. It is stored especially in the seeds, but also in the roots, tubers, fruits, stems and leaves of the plants, where in many cases it plays an important part in feeding the young, germinating plant. The starch grains which are found in the interior of the cells are of a characteristic size, shape and appearance, for each ılar variety of plants, a fact that aids greatly in the detec- f adulteration, especially in cereals.

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[1] Human Foods, Snyder, p. 8.

[2] Zeitsch. physiolog. Chemie, 47 (1907), through Sherman, Chem. of Food and Nutrition, p. 311.

ırch with sugar may be called the "basic foods" of man, as are the central and most important constituents of the ble foods which he utilizes. These foods also contain fats itrogenous constituents, which of course are essential nts.

STARCH CONTENT OF FOODS

ls:	Per cent.
Wheat flour	75
Rye flour	78
Oatmeal	68
Corn meal	71
Rice	79
Buckwheat flour	77
Barley	62
Millet	60
, stem and tubers:	
Potato	18
Sweet potato	

water are not dissolved, and can readily be filtered from the liquid. In making starch paste it is necessary to heat starch in water to at least 70° C.; the grains then swell to many times their original size, and if not separated from each other by an abundance of liquid, or some other substance such as fat or sugar, they stick together forming lumps. In a paste made below the boiling point of water the starch grains are unbroken, though much swollen, and on standing such a paste separates, the starch grains sinking to the bottom. At a boiling temperature the outer layer gradually dissolves and the starch makes a more homogeneous paste.

A starch paste is readily made by first mixing the dry starch with cold water, and then pouring the mixture into a large quantity of boiling water, and boiling for a few minutes. Thus prepared, the starch paste is semi-transparent, and free from lumps. It will mold or turn sour after a few days, unless preserved by some antiseptic, as borax or an essential oil.

When starch is cooked for some time it is so changed as to be more readily acted upon by the digestive juices. When heated with hydrochloric acid starch is hydrolyzed to mixtures of dextrin and maltose, and finally to glucose. Starch is also hydrolyzed by the ptyalin of the saliva producing dextrin and maltose, as in the previous case.

Test for Starch

To detect starch, boil the material to be tested for a few moments with water, cool, and add a drop or two of tincture of iodine, when a rich purple-blue color will be seen in case starch is present. Raw starch also gives the iodine reaction although more slowly, and different classes of raw starch react differently with iodine. The color fades from the iodine-starch solution when it is heated, but returns again on cooling.

Glycogen $(C_6H_{10}O_5)_n$ is sometimes called "animal starch," as it appears to have the same function in animals that starch has in plants. It is important as serving as a "storehouse" of reserve and quince seed and many roots.' Gum tragacanth is an ant commercial product containing bassorin. The digesti- f gums has not been very thoroughly studied.

DISACCHARIDS

accharids form a group including cane sugar, malt sugar and gar ($C_{12}H_{22}O_{11}$). When acted upon by weak acids or fer- they break up, by hydrolysis in such a way that cane sugar ing up the elements of water yields glucose and fructose, gar gives glucose, and milk sugar under similar conditions lucose and galactose.

e sugar (sucrose or saccharose) is by far the most impor- these sugars. (See p. 101.) It is found in the juice and certain plants, and is an important constituent of fruits. heated it yields barley sugar and later caramel. One part r is soluble in 0.46 parts of water at 77° F., and in 0.2 parts ng water.[1]

lt sugar (maltose) is formed in the process of malting

MONOSACCHARIDS

In the group monosaccharids are included glucose, fructose, galactose, mannose, and sorbinose ($C_6H_{12}O_6$). These sugars are all soluble substances, unaffected by digestive enzymes, and if not attacked by bacteria in the digestive tract they are absorbed and enter the blood current unchanged.[1] They are readily susceptible to alcoholic fermentation and are utilized for the production of glycogen in the animal body and in the maintenance of the normal glucose content of the blood.

Glucose, grape sugar or **dextrose,** is abundant in fruit and plant juices, and in honey. It is manufactured commercially by the hydrolysis of starch. (See p. 122.) It has only two-fifths the sweetness of cane sugar.

Fructose, fruit sugar or **levulose,** occurs with glucose in plant and fruit juices and in honey. It serves, like glucose, for the production of glycogen in the liver, and the latter by hydrolysis yields glucose. It ferments with yeast and yields alcohol, but more slowly than dextrose. Fructose forms crystals of the rhombic system, but crystallizes with difficulty. The sugar in fruit, often called *invert sugar,* is usually a combination of glucose and fructose, and forms granular masses in raisins and other dried fruits.

Galactose, although not found free in nature, is produced by the hydrolysis of milk sugar either by acids or enzymes, and appears to promote the formation of glycogen in the animal body. Galactose is also produced by the hydrolytic cleavage of certain gums and of Carrageen moss. (See p. 305.)

Mannose is produced by the oxidation of mannite which occurs in manna, in celery and other roots and barks, but does not exist ready formed in nature. It is also a product of the fermentation of cane sugar, under certain conditions.

Sorbinose is the sugar found in the juice of the fruit of the mountain ash and the service tree.

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[1] The Chemistry of Food and Nutrition, Sherman, p. 6.

as such does not occur in living blood, but is one of the
cts into which the fibrinogen breaks up when blood is ex-
to the air. **Vitellin** is the principal protein found in egg

e **glutenins**[1] constitute the largest part of the nitrogen com-
s of cereals. The tenacious substance which is left after
ng the starch out of wheat flour (see p. 34) is a protein of
ass. There are also alcohol-soluble proteins in cereals, such as
n from wheat and **zein** from corn. The gliadin and glutenins
er constitute about 80 per cent. of the total nitrogenous
ial of wheat.

cording to the recent classification mentioned, the term
inoids should be restricted to the proteins found in cartilage,
feathers, hair, hoofs, horns and nails. The one which occurs
tilage and bone is called **collagen**; that in horns, hoofs and
r tissues, a substance that contains considerable sulfur, is
keratin. Commercial **gelatin** is derived from the collagen
is extracted especially from the tendons. (See p. 358.)

(c) **Derived proteins,** include proteans, metaproteins, coagulated proteins, proteoses, peptones, and peptides.

Lecithoproteins are derived from the yolk of eggs, the mucous membranes, the kidneys and other sources, and contain lecithin, a peculiar phosphorized fat.

From this brief description it will be seen that, a knowledge of the different proteins, particularly as to solubility and effect of heat, acids and ferments, is necessary to a proper understanding of foods and their uses.

Non-proteins

(d) **Extractives,** amides and amino acids.

There are also existing in foods a few nitrogen compounds that are not proteins. Among these may be mentioned the **amides,** bodies found especially in plants, such as the asparagine of asparagus. These substances seem to be of importance in the transfer of the nitrogen compounds from one part of the plant to another, as from the stem to the seed,[1] and they are supposed to be of less value as muscle-formers than the proteins. The **extractives** that are obtained from beef, after the precipitation of the albumins by boiling, contain the compounds **creatin** ($C_4H_7N_3O_2$) and **creatinin** ($C_4H_7N_3O$) which seem to have little or no food value (p. 356).

MINERAL SALTS

The mineral salts, especially the compounds of the elements iron, calcium, magnesium, potassium, sodium, chlorine, sulfur and phosphorus, enter into the animal body and take part in the process of metabolism as essential constituents of the organic materials of the food. They are of importance in three ways: (1) "as the constituents which give rigidity and comparative permanence to the skeleton, (2) as essential elements of the protoof the active tissues, (3) as salts, held in solution in the of the body, giving these fluids their characteristic influence he elasticity and irritability of muscle and nerve, supplying aterial for the acidity or alkalinity of the digestive juices ther secretions, and yet maintaining the neutrality or slight scence of the internal fluids as well as their osmotic pressure olvent power."[1] In the study of nutrition very careful ion has been given to the rôle which the various salts, as the des, sulfur and phosphorus compounds, calcium and iron unds play in the process of animal nutrition. These nic materials are abundant in both vegetable and animal tuffs, and their occurrence, and relative quantity as a part diet should be always considered.

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[1] Loc. cit.

HEAT UNITS OF FOOD COMPOUNDS

nce reference is frequently made to the amount of energy ble from different foods it is important briefly to define the

Energy Value of Foods	Calories
Sirloin steak	1210
Corned beef	1655
Fresh codfish	310
Eggs	720
Milk	325
Butter	3615
Oysters	260
Wheat flour	1645
Oatmeal	1845
Sugar	1820
Molasses	1360
Potatoes	375
Squash (canned)	250
Apples	320

The inspection of these values affords an opportunity for the comparison of different foods. The author in discussing energy points out that it is important also to distinguish between the heat produced when substances are burned in the calorimeter, and the heat or energy that is available when used in the body, as it never happens that the combustible portion of a ration is entirely consumed in the body. This is the case because the food is never all digested, the digested proteins are never fully burned, and there is usually an escape of unconsumed gases from the alimentary canal, especially in the case of farm animals. As actual work is performed in the process of digestion, the term "net energy" has been introduced to apply to that amount of energy which is available, after that used up in the digestion and preparation of the food for use in the body has been subtracted.

Planning of the Diet; Vitamines

Although it is not the province of this work to discuss at length dietetic topics, something should be said in regard to the newer knowledge in regard to nutrition. From the researches of Fischer, about the year 1900, it was shown that there is a great difference in the composition of proteins from different sources.

ɔw regard most proteins as bodies capable of being resolved t least 18 simple digestive products, called amino-acids, may be absorbed into the blood.[1] Most natural foods n several of these proteins, but there are some foods which to be lacking in one or more of these indispensable conts of an adequate diet. "The proteins of any single foodnay be regarded as biologically complete, but their biological differ greatly, depending on the yield of the several aminowhich can be obtained from them." It has also been shown he so called "deficiency diseases", such as scurvy, pellagra and beri beri, are due to a faulty diet. Experiments e lower animals[2] have also show that growth could be ained when butter fat or egg fat was contained in the food, ot satisfactorily with such fats as that from lard or with ble fats. Further experiments by McCollum, Davis and ,[3] indicate that, in addition to the proteins, fats, carbotes and mineral salts, the diet must also contain two as yet tified substances, or groups of substances.

Investigations recently made show that the average diet of the people of the United States is derived from the following sources;—

	Per cent
Meat and Dairy products	37
Fish	2
Cereals	31
Irish and sweet potatoes	13
Other vegetables	8
Miscellaneous	9
	100

CHAPTER II

COMPOSITION OF CEREALS AND THE MANUFACTURE OF STARCH

e term cereals includes the plants of the grass family (Gram-
vhich are used as food. Wheat, rye, oats, barley, rice, corn
) and millet belong in this class, and buckwheat and quinoa,
gh not grasses, are here considered. The grain consists of
rm, and the endosperm with its coverings, which are the
nost utilized for human food.

WHEAT (Triticum vulgare)

nsidered from the viewpoint of general use, there is no modified by the soil and climate yet we commonly speak of wheat as—

1. Soft, starchy or winter wheat, which is sown in the fall and harvested in June or July, and,

2. Hard, glutinous or spring wheat, which is sown in March or April, and harvested in late July or August. The climate, of course, determines which of these can be cultivated to best advantage, in each particular locality, but in general the winter wheat is grown in the more temperate climates, and the spring wheat in the north where the summer is shorter. On the Continent the upland steppes of Russia furnish the greatest quantity of wheat, although large quantities are grown in India, Siberia, South America, and Central Europe. In the United States of America[1] the prairies of the middle west and northwest, which are in many respects similar to the steppes of Russia, are best adapted to the growing of wheat. This is especially true of Minnesota, Wisconsin, Nebraska, the Dakotas, Illinois, Ohio, Missouri, Kansas, Indiana and New York. It is interesting to note that this cereal is grown successfully in Canada, as far north as Manitoba, and Assiniboine. In some countries as Bohemia, parts of Russia, France and Germany, Scotland and Ireland, on account of the cost of wheat, it is partly replaced as food by rye, barley or oats.

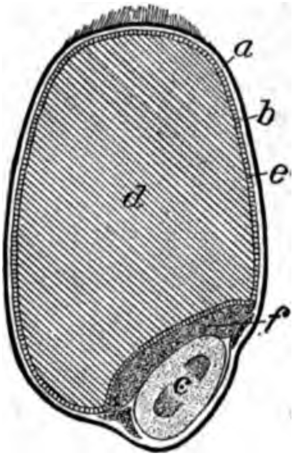

Fig. 4.—Structure of the wheat grain. *a*, Wall of the ovary; *b*, testa; *c* and *f* embryo; *d*, starchy endosperm; *e*, aleurone layer. By permission U. S. Dept. Agric.

Structure of the Wheat Kernel

The wheat kernel, or berry, when seen through the microscope has the structure as shown in Fig. 4. If the kernel, after

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[1] References to the "United States" in the following pages are understood to mean "United States of America."

ng a longitudinal section, be examined with a microscope
 power, the germ may be seen opposite the rounded end, with
arch and aleurone surrounded by the bran cells, constituting
ulk of the grain. The germ constitutes about 6 per cent. of
eight of the kernel. Its cells, as well as those of the endo-
, are rich in enzymes which, under the right conditions,
form the insoluble starch and protein of the endosperm into
s, dextrins and amides, which the embryo plant is able to
b during germination. If the grain is stored dry and is
cted from moisture it does not deteriorate, but loses slightly
ight from drying. It is, however, liable to become infested
certain insects, particularly the granary weevil and the rice
l, but these can be destroyed by the use of carbon disulfide in
ins where the grain is stored.

Spelt

elt (Triticum spelta) is the name applied to a cereal which
sely allied to both wheat and barley. It has been suggested

The hand mills of the Israelites, and those found in the ruins of Pompeii, belong to this type. (Fig. 5.) Later the mortar and pestle was almost universally used, and this was followed by stones run by wind or water power. The old fashioned burr-stone mills consist of a fixed nether millstone, upon which the upper stone revolves. The grain drops into an opening in the center of the upper stone, and gradually works outward between the surfaces of the two stones which have a grinding surface cut in radiating lines. The meal is "bolted" or sifted to remove the bran. One advantage of this process over the modern roller milling is that the entire grain is ground, so that the finished product contains some of the bran, cerealin layer, and germ, which bolting does not remove. This flour, however, does not keep so well, is darker in color and more liable to become lumpy.

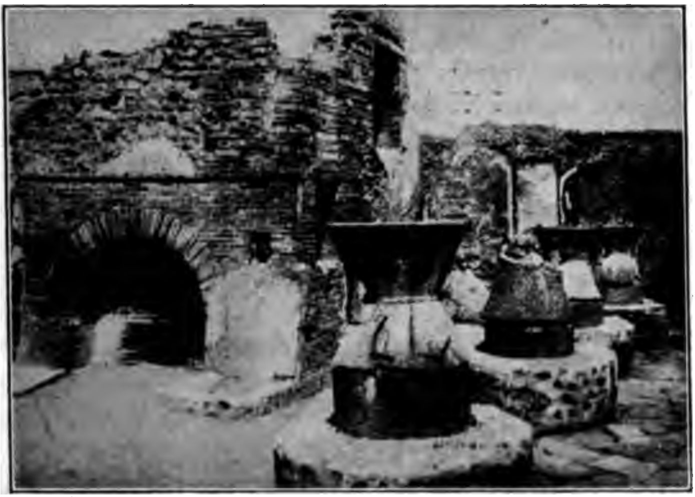

FIG. 5.—Mill stones and oven, Pompeii.

2. The Roller Process

It is only within the last fifty years that the "roller" process for making flour, which came originally from Hungary, has been

uced into America. By this process about 75 per cent. of
ain is put on the market as a merchantable product. "The
is first screened and cleaned, then passed on to corrugated
r the 'first break,' where it is partially flattened and slightly
d, and a small amount of flour, known as the 'break flour,' is
ted by means of sieves, while the main portion is conveyed
h elevators to the second break, where the kernels are
completely flattened and the granular flour particles are
lly separated from the bran. The material then passes
everal pairs of rolls or breaks, each succeeding pair being set
nearer together. This is called the *gradual reduction proc-*
cause the wheat is not made into flour in one operation.
complete removal of the bran and other impurities from the
ings is effected by means of sieves, aspirators and other
s, and the purified middlings are then passed on to smooth
here the granulation is completed. The flour finally passes
h silk bolting cloths, containing upward of 12,000 meshes
uare inch. The dust and fine débris particles are removed

more than 1 per cent. of ash, and not more than 0.50 per cent. of fiber.

The grades of flour usually on the American market are First Patent, or highest grade, in which the gluten has a greater power of expansion than any other grade; Second Patent; "Straight" or standard patent, which includes First and Second Patent and first clear grade, and is the ordinary bread flour of the market; first clear; second clear, which although containing more gluten than higher grades does not contain the gliadin and glutenin in the right proportions to make good bread; and "Red Dog." the lowest grade. Other products which are used mostly for stock foods are shorts, or middlings and bran. In English milling practice the roller-milling products are sold under the following grades.[1] Straight Run, which consists of about 70 per cent. of the entire weight of the grain used; Patent Grade, and Baker's Grade.

Flour on standing sometimes absorbs water, and usually bleaches, on account of the action of enzymes or natural ferments present.

Varieties of Flour

Graham flour, which was first recommended by Dr. Sylvester Graham, an American vegetarian, in his book written in 1839, is the "unbolted wheat meal" made by simply grinding the scoured wheat. When properly made it contains a relatively larger proportion of the intermediate products—such as coarse and fine middlings of good grade—than does much of the so-called Graham flour on the market, which is sometimes made by mixing inferior grades of flour with feed-bran.[2] The term "entire wheat" flour or "whole wheat" flour as used in the trade is a misnomer, as it is often applied to a product made from the cleaned wheat, from which some flour has been abstracted.

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[1] Foods, Their Origin, Manufacture and Composition, Tibbles, p. 388.

[2] U. S. Dept. Agric. Bur. Chem. Bull. 164.

uten flour, which is considered especially valuable as food iabetic patients, ought to contain less starch and more than the ordinary flour. According to the U. S. standard it ins 5.7[1] per cent. of nitrogen. The name unfortunately has misapplied to various special brands, which are little if any in gluten than ordinary flours.

he *Durum* wheats, which somewhat resemble barley, while ially adapted to the making of macaroni, are not as valuable neral milling purposes as the ordinary varieties. The ker- re hard and almost glassy, and the beards are exceptionally

COMPOSITION OF WHEAT

he composition of wheat is as follows:

	Mean of 227 samples of wheat analyzed at the World's Fair[2]	Mean given by König. 420 samples[3]

and which is present to the amount of 0.6 to 0.7 per cent.: an albumen, which forms from 0.3 to 0.4 per cent. of the wheat; a protèose; a gliadin, soluble in dilute alcohol and forming about 4.25 per cent. of the seed, and glutenin about 4 to 4.5 per cent. The gliadin and glutenin together form the gluten. These latter form about 85 per cent. of the protein of wheat. Gliadin in the best flours is present in about the proportion of 65 per cent. of gliadin to 35 per cent. of glutenin, and these, due to the presence of mineral salts, are prevented from being wholly soluble. By this gluten then, the particles of flour, which consist largely of starch, are bound together to make a tenacious dough.

Blending Different Wheats

Wheats from different countries as well as different kinds from the same country have different qualities. The English market is supplied with wheat from England, Scotland, France, Hungary, Australia, America, Russia and India. As these differ in quality and value, much skill on the part of the miller is required to so blend the different grains as to produce a satisfactory grade of flour. The American miller mixes wheats from different sections, and hard and soft wheats, to produce the required grades. In the large mills the various grades of flour are tested in the laboratory.

Bleaching of Flour

Some flours, especially those of the higher grades, are white, while the lower grades are darker. As the white flour commands a higher price, it is to the advantage of the miller to get as much of the wheat into white flour as possible. This is done by various processes of bleaching, by the use of ozone, chlorine, or peroxide of nitrogen (NO_2). A common method of applying nitrogen peroxide gas to flour is to pass an electric charge through a confined volume of air, thus causing a partial combination of its oxygen and nitrogen, and in a special apparatus to bring the fine

in close contact with the nitrogen peroxide. The latest
of the U. S. Dept. of Agriculture is that "Bleached flour
e shipped under the jurisdiction of the law only under the
tion that the bleaching has not concealed inferiority or im-
l the quality or strength of the article, and then only on con-
that it is branded plainly to indicate that it has under-
process of bleaching."[1]

RYE (Secale cereale)

ye, which came originally from the region east of the Austrian
is extensively used for bread making in many European
ries, especially France, Germany, and Russia. It is not
ry ancient origin, and was not cultivated in the Roman
re earlier than the Christian era. In the United States
sed to some extent by the farmers who grow the grain, and
finds great favor among the immigrants who have become
tomed to the use of rye bread in the old country. The chief

position the gluten is more sticky than that of wheat, and the resulting bread is darker and less porous. In parts of Germany a black bread made from rye and known as "pumpernickel," is a common food for the working people. This is a "sour-dough" bread, in which the fermentation is started with dough from a previous batch. The *Schwartzbrod*, quite common in certain sections, is made from a coarser flour than that used for "pumpernickel." This is not an economical food, as far as the protein digestibility is concerned, for in coarse rye bread as much as 42 per cent. of the total protein is lost during digestion, as compared with only 20 per cent. in the case of white bread.[1] The soluble proteins, which are more abundant in rye than in wheat, act upon the insoluble proteins and render rye bread moist, fine grained, and of small volume in comparison with the spongy, wheaten loaf. These same qualities, however, make rye flour an excellent medium for the growth of yeast cells, therefore a small quantity of rye flour is often used with the wheat in the preparation of the "sponge" used to raise the dough. In making rye bread, rye flour is commonly mixed with barley or wheat flour or corn meal. When wheat is used the best proportion is two parts of wheat to one of rye. In France a mixture of wheat and rye are combined for bread making under the name of **méteil**, and in Spain and Greece a mixture of barley and rye, has the same name. It should be noted that bread made from mixtures of different flours, since it is cheap and nutritious, might well take the place of straight wheat bread in cases where economy of food is to be considered.

The malted and fermented rye is a common source of alcoholic liquors, especially whiskey and in Russia "*vodka*." (Alcohol, p. 144.)

There is a peculiar fungus called "ergot," which sometimes grows upon rye giving it the name "spurred" rye. Ergot possesses certain poisonous properties, which, although valuable in medicine, render the product dangerous for use either by man or the lower animals. (See also U. S. Serv. and Reg. Ann. No. 25.)

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[1] Food and Dietetics, Hutchinson, p. 220.

OATS (Avena-sativa L.)

ats, a very valuable cereal, which is always cultivated, and
ever been discovered growing wild, is used as food both by
and beast. It seems to have been the original grain plant of
pe, where it has been known for 2000 years, and was used
reat Britain more than 600 years ago. It grows readily
ever the climate in the growing season is cool and moist.
nore susceptible to drought than wheat and some other grains.
e United States, it can be readily grown in the south by sow-
n the fall, and in the north by sowing in the spring. In
and oatmeal has long been a favorite food material, and in
Inited States within the last fifty years, it has become, one
e most important of breakfast foods.

Milling Oats

y the ordinary process of threshing and winnowing, the outer
is not removed, and so oats, unlike other grains, comes

Oatmeal is unique among the cereals in the amount of protein and fat contained. Of the nitrogenous matter, 94 per cent. is in the form of protein, so that it can be readily digested, although experiments are wanting to show exactly how large a proportion really is available as food in the human system. These proteins consist of *avenin*, sometimes called oat myosin, oat legumin, or oat casein, and a small quantity of oat gliadin. The avenin is similar to the legumin of peas but it contains more sulfur. Oats contain more fat than wheat, although it is of the same character. The mineral salts are also abundant and of great value in the process of nutrition.

Cooking Oatmeal

In order to be fully digested, oatmeal should be cooked longer than the thirty to forty minutes usually suggested. Digestion experiments[1] show that when oatmeal is cooked for four hours or more, the diastase ferment acts on it more readily, and it is more easily digested than when cooked for thirty minutes. For those of feeble digestion, long cooking of oatmeal is positively necessary, otherwise gastro-intestinal irritation will result. That the oatmeal, as served at hotels and restaurants, is often very imperfectly cooked, is evident both from the taste and appearance. As there is no gluten in oats similar to that in some other grains, ordinary bread cannot be made from this cereal, but it has been used mixed with wheat and rye flour to make a very nutritious bread of fair quality. Oats can be cooked most thoroughly and completely in the form of porridge, because the heat is so much more readily applied to all portions of the mass. "Haggis" is a favorite Scotch dish made from chopped calves' liver boiled with oatmeal.

Oatmeal as Food

Since oatmeal is such a richly nitrogenous and "hearty" food, it is important, if the health be preserved, that those who make it a portion of their diet, live much of the time in the open air. Scotch Highlanders are often mentioned as a race who have nourished on this remarkable food. The Scotch "Groats" kernel freed from its outside covering and then ground ut the removal of the germ. For the genuine product the is heated or parched for several hours over perforated iron s, before it is ground. The product known as "rolled oats" een upon the market for some years in the United States. claimed that the great pressure applied, and the heat em-d during the process, rupture the cell walls and break down ellulose, so that the subsequent preparation for the table res less time than if other methods were used in the facture.

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[1] Minn. Exp. Sta. Bull. No. 74.

ome manufacturers claim that by a special process of manu-ring, their product is vastly superior to others, but there reasom why the consumer should in normal times pay more 7 cents per pound for a good wholesome oatmeal. Package it is true have the advantage of protection from dust and later, barley meal was the common food of laborers in England, and as late as 1858 barley is spoken of as the common food of the people living in the mountainous districts of Sweden, Switzerland and Scotland.

In most countries barley has gradually been replaced by wheat, as the latter is transported all over the world, and it no longer becomes necessary for people to live exclusively on the foods that are produced in their immediate vicinity. Barley is grown in almost any latitude in the United States, the method of cultivation being similar to that for wheat or rye. The yield per acre exceeds that of most other grains.

Composition of Barley

Atwater reports the following composition of barley.

	Pearl barley	Barley meal
Water	11.50	11.90
Protein	8.50	10.50
Fat	1.10	2.20
Carbohydrates	77.80	72.80
Cellulose	0.30	6.50
Ash	1.10	2.60

Barley contains a relatively large amount of mineral salts, fat and undigestible cellulose, but contains less protein and less digestible carbohydrates than wheat. Osborn[1] divides the protein of the whole barley grain, which amounts to 10.75 per cent., as follows: Leucosin (albumin) 0.3 per cent.; proteose and edestin (globulin) 1.95 per cent.; hordein, similar in physical and chemical properties to gliadin, 4 per cent.; and insoluble protein 4.5 per cent.[2]

[1] Am. Chem. Jour., 1895, 17, pp. 539–567.

[2] See also Chem. Study of Am. Barleys and Malts, U. S. Dept. Ag. Bur. Chem. Bull. No. 124.

Uses of Barley

barley contains no gluten it does not make good bread
ixed with an equal quantity of wheat flour a product of fair
y can be made. The meal has been used for making "barley
" from the earliest times. Barley water has been found
an excellent demulcent and cooling drink for invalids,
gh the amount of nutriment contained in it is less than 1
nt., which is, of course, almost negligible. Pearl barley,
is the whole grain polished by attrition after the removal of
sk and germ, and products of this class, similar to oatmeal
ations, require long boiling—from one to two hours—in
to permit of their easy digestion. As an addition to soups
finds great favor.

ide from its use in feeding horses and cattle, the chief use of
is in the manufacture of beer and alcohol. *Malt*, which is
me for sprouted and dried barley, has the property of
ting the starch into fermentable sugar on account of the

the temperate zone, but it has not until recently been extensively cultivated, except in the western hemisphere. At the time of the potato famine in Ireland corn was imported into that country, and since that time has held a very important place as a cheap food material.

Although Indian corn was not known to the civilized world until the discovery of America, it has gradually increased in importance so that to-day, in the United States at least, it stands next to wheat as a cereal used for the food of man.

Corn may be said to be the most important agricultural crop in the states of Indiana, Illinois, Iowa, Missouri and Kansas. In the United States it far exceeds wheat in the size and value of the crop produced.[1] There were 30 acres of corn grown in the James River settlement in 1611: there were 102,075,000 acres grown in the United States in 1919. In the southern United States corn and its products are much more commonly used as human food than in the north. Although used quite extensively in Italy, other European states have been rather slow to introduce corn as a staple food.

Cultivation of Corn

There are a number of varieties[2] of corn grown, which may be distinguished as husk-kernel corn, pop corn, flint, dent, soft and sweet corn. Some of these are peculiarly adapted to particular localities and climatic conditions, and others will grow almost anwhere. Ordinary corn has been much improved in quality and nutritive value by judicious selection and cultivation. To cultivate the crop successfully, an abundance of rain during the growing season is required. The hills in which three or four stalks grow are about 4 feet apart, and the ground must be worked several times, and kept free from weeds. On the prairies of the middle west of the United States, the yield is sometimes as high as 110 bu. to the acre, and there are occasional stalks measuring 16 feet ght, so rich is the soil, and so ideal are the conditions for the h of the plant. On account of the hard, flinty nature of its le covering, corn keeps well if stored in a dry place. The ure of the grain or kernel is shown in Fig. 6.

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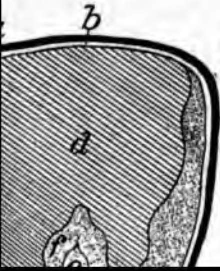
[1] Maine Ag. Ex. Sta. Bul. No. 131.

[2] Foods and Their Adulteration, Wiley, pp. 224–225.

Milling of Corn

nong primitive people corn meal was made by pounding the in a hollow log by the use of stones; later, mill-stones were used, which for convenience were turned by water power. From this practice we have the term "water ground," for the meal made in this way. Some of the bran was often removed by the use of sieves, and later a method was devised for kiln-drying the grain so that the skin could be the more readily removed. In the modern milling operations, not only



nary meal, and some of its characteristic flavor, which by many is much appreciated, is lost.

Composition of Corn

The average composition of corn is

	American corn[1]	Sweet corn[2]	Corn meal[1]
Water	10.95	8.40	12.57
Protein	9.88	11.48	7.13
Fat	4.17	8.57	1.33
Carbohydrates	71.95	66.72	78.36
Cellulose	1.71	2.82	0.87
Ash	1.36	1.97	0.61

The chemical analysis shows that corn is rich in fats,[3] although somewhat deficient in protein and mineral salts. The following is given as the composition of the proteins by Osborne.[4] Zeins, solubles in alcohol, 5 per cent.; insolubles, 3.14 per cent.; globulins, 0.39 per cent.; albumins, 0.06 per cent.; making a total of 8.59 per cent.

Corn Oil

The oil of corn, sometimes called "maize oil," consists of mixed glycerides of oleic, palmitic and stearic acids. Commercial corn oil is prepared from the germ which is removed from the corn by some of the milling processes, especially those preceding the manufacture of starch and brewers grits, and in the process of making glucose.

Corn Starch

Corn starch, which is so extensively used in the preparation of puddings and for infants' food, is one of the most important corn

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[1] U. S. Dept. Agri. Div. Chem. Bull. 50.

[2] Richardson.

[3] For prop. and comp. of corn oil, see J. Am. Chem. Soc., Vol. 23, p. 1–8.

[4] J. A. C. Soc. 19, p. 525, also Osborne, Loc. cit., Vol. 13, Vol. 14.

ucts. In the use of corn starch, under whatever name sold,
ould not be forgotten that the product is nearly pure starch,
o form a satisfactory balanced ration its use should be sup-
ented with foods rich in nitrogenous material and fat. Corn
h is a common adulterant of the more expensive starchy foods,
as sago and arrow root.

Cooking Corn

s corn does not contain a true gluten like wheat, it cannot be
for making an ordinary bread raised with yeast, but there
umerous ways in which corn meal may be prepared as food.
roduct made by boiling the meal with water is called *stirabout*
land, *polenta* in Italy and *mush* or *hasty pudding* in the United
s. When the meal is baked in cakes it is known as *johnny*
(said to be a corruption of journey cake). "Ash cake" is
by wrapping the dough in cabbage leaves and baking in hot
. In the Southern States the cakes are known as *corn pones*
e cake; in Mexico and South America as *tortilla* (*tortio*)

importance as a canned food. It compares favorably with the potato in food value, having 73 per cent. of water, while the potato contains 75 per cent.; sweet corn contains 13.5 per cent. of starch; 6.00 per cent. of sugar, and 5.00 per cent. of protein. The fresh potato contains only 1.20 per cent. of protein. Corn may be boiled "on the cob" or cut from it, or it may be roasted, but in any case it is eaten hot. (See succotash, p. 192.)

Canned Sweet Corn

In the United States canned sweet corn has become almost a family necessity. It is of better quality for canning when grown in the north, and the principal canneries are located in Maine, Maryland, New York, Indiana, Michigan, Iowa and Wisconsin.

It happens unfortunately that there are opportunities and an incentive to adulterate sweet corn, and so it was formerly found bleached with sodium sulfite, to make it white, or sweetened with *saccharin* (see p. 130), or at least with cane sugar, and thickened with starch instead of being canned in its natural state.

Pop Corn (Zea everta)

Pop corn is peculiar from the tendency of its kernels to turn inside out upon heating. It differs from the ordinary flint corn in having a larger proportion of corneous endosperm or horny substance associated with the starchy portion of the kernel.[1] The ears and kernels of pop corn are small and the whole plant is diminutive compared with other varieties. The kernels may be red, yellow or white, but there is less demand for the colored varieties. The white rice corn is the variety most in favor. More than 280,000 bushels are grown annually in the United States, the largest producers being the states of Iowa and Nebraska.

The cause of the popping of corn is the expansion of the moisture contained in the starch cells. The seed coat should be sufficiently hard and dry to afford considerable resistance to the expansion, otherwise the corn does not pop well. For

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[1] U. S. Dept. of Agri. Farmer's Bull. No. 554.

ng, the corn should contain about 12 per cent. of moisture,
properly stored it will retain this quantity for several years.
orn is not ready for marketing until the summer following the
n in which it is grown.

op corn is used more as a confection than a food, but it is
e same time wholesome and nutritious. The principle prod-
are pop-corn balls, corn bar, sugar-coated pop corn, pop-
bricks, and "crackerjack," which is a mixture of pop corn
eanuts held together with sugar and glucose.

Corn Flour as an Adulterant

he mixing of corn flour with wheat flour is considered an
eration in the United States, but this mixture is allowed if
act is stated on the package and when a small revenue tax is

Pellagra not Caused by Eating Corn

wheat. This opinion, it appears, has no justification either from the chemical composition of the two bodies, or from recorded digestive or nutritive experiments. In round numbers corn contains twice as much fat or oil as wheat, three times as much as rye, twice as much as barley, and two-thirds as much as hulled oats. Indian corn has nearly the same content of nitrogenous matters as the other cereals, with the exception of oats." In fuel or energy value corn stands very high, having in fact nearly 1800 calories per pound, or 100 calories above the average of the cereals. This is of course due to the large proportion of fat which it contains. Sweet corn sometimes causes irritation in the intestines on account of the presence of the tough exterior coating which resists digestion.

The increase in the use of corn, in the life of the far East, bids fair to be an important economic factor. Indo-China and the Philippines have begun raising corn in the place of rice and millet. In the Philippines, a campaign of education, begun by the U. S. Dept. of Agric., is beginning to bear fruit. The crop seems well adapted to this climate, and 2 or even 3 crops are raised annually. It is believed that the raising of corn will do much to improve the condition of the natives, as it renders them less liable to a famine when the rice crop fails.[1]

RICE (Oryza sativa)

Rice is a native of India and southern China, and has been known in Asia as a food product from the earliest times, in fact there is evidence of its being in use in China as early as 2800 B. C. It is grown principally in the East, in southern Europe, in the West Indies, and the southern Atlantic and Gulf States. It was introduced into the United States in 1694, and its cultivation is rapidly extending especially in Louisiana, Texas and Arkansas, which three states now furnish three-fourths of all the product of the country. Before the Civil War, North Carolina, South Carolina and Georgia were the principal rice-producing states.

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[1] D. Cons. Tr. Rep. U. S., 1913, No. 254.

Wild Rice

variety of wild rice which will flourish wherever there is an
dance of fresh water, is found in this country. It grows in
w water and in that which is several feet deep, in the lake
ns especially throughout the Mississippi Valley, and is
tant as furnishing much of the food for the game birds which
te across the United States. The Menominee Indians are
o be named from the Indian word "manomin," or "wild
In common with other Indian tribes they considered this
as so important a food factor that it was worth fighting for.
it is related that the Chippewas drove the Dakotas out of the
esota lake region so that they might themselves have access
e rice fields. The Indians gathered the crop by going
in their canoes and collecting the heads.

Use of Rice

Rice grows best in damp soils, especially those underlain by a semi-impervious sub-soil, and in localities where it can be flooded at certain seasons. During the germination and growth of the crop water is run onto the field several times, but later the field is allowed to dry so that the crop, which is usually planted in drills, can be hoed. (Fig. 7.) The final irrigation is kept up until about eight days before the harvest. Where the ground is sufficiently firm, reaping machines are used in harvesting the rice; otherwise it must be cut with the sickle.

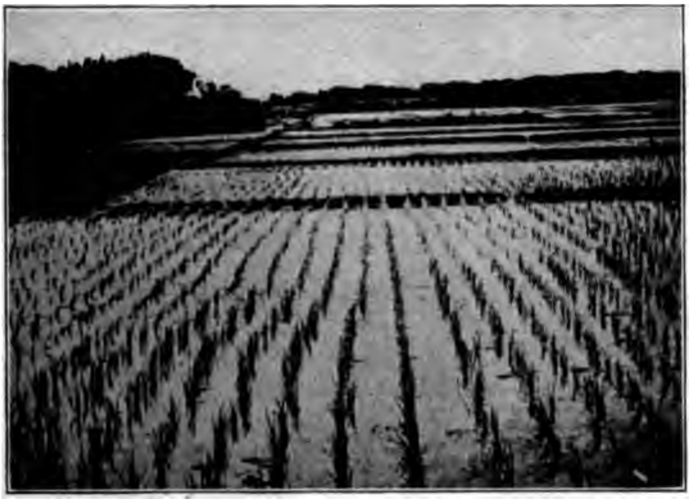

FIG. 7.—A rice field. (By permission, Central Scientific Co.)

Milling

When the grain comes from the thresher it is known as "paddy" or rough rice, from which the hull is afterward separated. This operation is accomplished by the use of a large mortar and pestle (Fig. 8) but in modern practice a "hulling machine" has been devised which expedites the work. (Fig. 9.)

For many years, the rice, as prepared for market by the

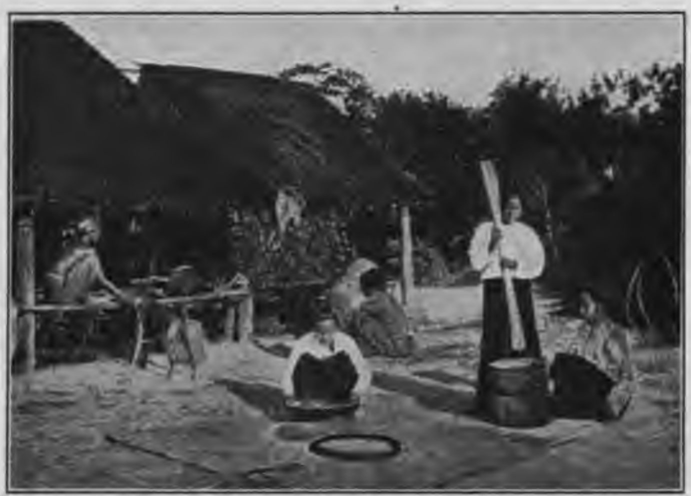

FIG. 8.—Hulling rice in Burmah.

simple process of hulling, was considered satisfactory, but there arose an apparent demand for a whiter and more highly polished product.[1] As a result elaborate machines are in use in the rice mills of the South, and elsewhere, in which, by means of leather rollers the outer layer of the rice and often the germ is rubbed off. (Fig. 10.) This process is inadvisable, first because much valuable nutritive material is removed, and second because by its use many whole grains are broken. In 100 pounds of rice polish (the material removed) there are 7.2 pounds of fat, while only 0.4 pounds per hundred are retained in the polished rice. The practice of polishing,[2] however, is still continued, and thus the best part of this important food is separated to be used as food for

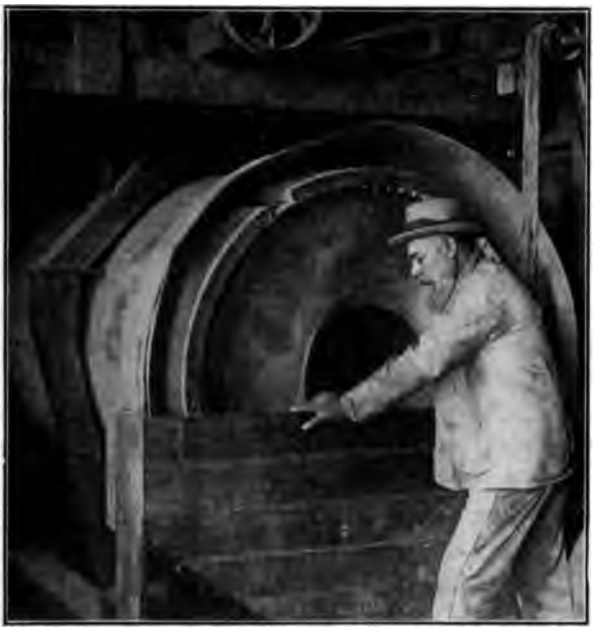

FIG. 10.—Polishing rice, Savannah, Ga. (Copyright, Keystone View Co.)

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[1] Food materials and their adulteration, E. H. Richards, p. 72.

[2] See Nat'l Geog. Mag., April, 1906, p. 3 (quoted by Richards).

, instead of being retained to enrich the grain to which it
gs. This practice is on par with the bleaching of wheat
another process which by many is thought to lower the
y of a wholesome food, simply to make it more salable or
r and more pleasing to the eye.

he loss by breakage in the process of milling and polishing,
m 25 per cent. to 60 per cent. While the whole grains sell
rmal times for 6 cents a pound, the broken grains sell for
half that price, and the smaller particles for less than 2
, yet all is equally valuable as food. The broken rice, how-
does not make as attractive a dish when cooked as do the
grains.

Composition of Rice

he average composition of rice is as follows:[1]

	In the husk	Hulled	Polished

Rice as Food

It is a mistake to suppose that the people of various Asiatic nations, who eat enormous quantities of rice, subsist wholly on this diet. Careful investigations at the Japanese village in the World's Fair in Chicago in 1893 show that in the diet of these people rice is supplemented by potted fish-roe, ducks' livers, fresh and dried fish, hard-boiled ducks' eggs, chicken or some food containing proteins. In those countries where rice is so much eaten, peas, beans and soy beans grow luxuriantly and are also used to supplement the diet. These protein-yielding foods are used with great economy, and not carelessly thrown away, as is too often the custom in the United States.

Cooking Rice

Since in rice the starch grains are smaller and of different structure from those of other cereals, rice does not need so much cooking as do the others. It absorbs nearly five times its weight of water when cooked. If cooked by boiling the rice should be stirred into a rather large quantity of salted water, which is kept boiling vigorously. It should not be stirred during the process of cooking. When the grains are soft the excess of water should be poured off and the rice should be dried for a moment in the oven. If cooked by steaming, sufficient time should be given so that each individual grain can swell and become thoroughly softened.

Digestion

Rice is easily digested, and is finally absorbed very completely in the intestines, so that practically all the starch is utilized. On this account rice has long been regarded as an excellent food for invalids and convalescents. If we regard rice as consisting wholly of carbohydrates, since it is richer in starch than any other cereal, an adult would require 1 pound and 3 ounces daily, or about 5 pounds of cooked rice.

Adulteration

ice admits of adulteration by coating or glazing with a mix-
of glucose, paraffin and talc. This treatment is said to give
better appearance, and to protect it from insects. Such
ions, especially of the mineral substances paraffin and talc,
absolutely indigestible, are considered adulterations, and are
ermitted under the U. S. Food Inspection decisions.[1]

Rice Products

here is a rice flour upon the market made by grinding the
en and imperfect grains, which although not suitable when
alone for making bread, finds numerous uses. During the
d War rice flour was extensively used in the United States
vas very popular as a substitute for a part of the wheat flour
aking bread; in fact it proved to be the most satisfactory
itute, and could be used up to 25 or 30 per cent., without

Composition of Millet

The chemical analysis of millet shows that it contains, in addition to the starch, 10 per cent. of protein and about 4 per cent. of fat.[1] Bread made from millet is nutritious and palatable when fresh, but soon becomes darker in color and crumbles readily. It occupies a place between wheat and rice in protein value. There are numerous varieties of millet, as durrha, sorghum-grass, and Indian millet. The seeds of the sorghum (sorghum saccharatum) furnish a starchy food, which has been used to a limited extent only. The seeds of the durrha are ground into a dark flour and used in Africa and the East for making bread. The juice of the sorghum[2] stalk is used in the United States, for making sorghum sirup (see p. 128) and in China for making alcohol.

BUCKWHEAT (Polygonum fagopyrum)

Buckwheat, although not a cereal, may conveniently be considered here. It was introduced into Europe from Manchuria and central Siberia and is at present grown in Russia, Brittany, Holland, and the United States. It is not of very ancient origin, as it was not introduced into Europe until the Middle Ages. In the United States the cultivation of buckwheat is carried on chiefly in the New England States, New York, Pennsylvania, and Michigan.

The seed is sown in the late spring or early summer and the grain matures very rapidly, often in 100 days. The abundant and very odoriferous white flowers furnish to the bees a dark honey of peculiar flavor, which does not command in the market as high a price as the honey made from other flowers.

Composition of Buckwheat

The brown, three-sided buckwheat grain contains from 11 to 15 per cent. of protein, 3.6 per cent. of other extractive, and r cent. of carbohydrates.[1] The flour which is dark in color be made by grinding the grain between stones and separating ajor part of the hulls by bolting, which is the old-fashioned or a finer grade of whiter flour may be made by the use of elaborate machinery.[2] In the former case the flour is more tious and furnishes a more palatable product, but it is not as . The color may be regulated by allowing more or less of ner hulls (middlings) to pass into the flour.

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[1] Bull. U. S. Dept. Agri. No. 45.

[2] U. S. Dept. Agri. Div. Chem. Bull. No. 37, p. 75.

Cooking

uckwheat flour is used, especially in Holland and the United s for making griddle cakes. The dough is raised with yeast, e flour contains enough of a glutenous substance to entrap the les of gas, and the "batter" is usually allowed to stand over . The "leaven" left over from one batch is used to start the ntation in the next. Buckwheat cakes are often eaten with , especially maple sirup, and are always served hot. The -rising" buckwheat flour on the market is the flour mixed tants of Chile, Peru and New Granada. The plant is an annual herb, which grows to the height of from 4 to 6 feet and will flourish at an elevation of 13,000 feet above the sea level. The flour is made into unleavened cakes, or the seeds are eaten in soup. The flour contains a high per cent. of protein, and a moderate amount of fat in addition to the starch.

KAFIR CORN

Kafir corn was introduced into the United States from South Africa in 1876.[1] It has been for a long time a staple food in Africa, India and China, but has been little used for that purpose in this country. On account of its drought-resisting qualities, it can be raised in some semi-arid places where it is difficult to raise Indian corn. It differs but little in composition and digestibility from the latter, but its flavor is somewhat stronger. Kafir corn meal requires longer cooking than does Indian meal.[2] Other cereals of this class recently introduced are milo, durra, feterita, kaoliang and shallu.

CEREALS RAISED IN THE UNITED STATES IN 1919

	Bushels
Corn (maize)	2,917,450,000
Wheat (winter and spring)	940,987,000
Oats	1,248,310,000
Barley	165,719,000
Rye	88,478,000
Rice	41,059,000
Buckwheat	16,301,000

In normal times the United States produced the following proportion of the world's staple cereals: Of corn 75 per cent.; wheat 25 per cent.; oats 24 per cent.; barley 11 per cent.; rye 2 per cent.; rice 0.5 per cent. The world war has shown the commercial importance of the United States, especially in furnishing food, to those countries where the normal supply had fallen short.

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[1] **U. S. Dept. Agrl. Farm. Bull. No. 559.**

[2] **Farmers'** Bull. No. 686.

THE MANUFACTURE OF STARCH

Nearly all the commercial starch is manufactured from corn, toes, cassava, rice and wheat. In the United States fives of the starch is made from corn and one-sixth from other ces. The starch from potatoes is used especially in the textile stries, although corn starch is now recommended for this pur, while that from cassava is used as tapioca, a special food uct. In Europe potatoes are the principal source for the ufacture of starch while in the tropics cassava is used for this ose.

Wheat Starch

There are two methods used in the United States for making h from wheat. In one process the dough is thoroughly mixed the starch washed out by the use of a suitable machine. The n which is thus separated is dried and put on the market

The "germ oil meal" which is prepared by grinding the "germ cake" is a valuable cattle food, containing about 24 per cent. of protein and 10 per cent. of fat. The "corn oil" finds many uses as a substitute for other fats and a large amount is exported. (See p. 324).

The starchy material separated from the germs is ground very fine and passed over bolting-cloth sieves. The bran which remains on the screens constitutes a valuable stock food. It is sometimes mixed with water and sold as "glucose feed" or "slop" for immediate consumption. The starch and so-called gluten which is passed through the sieves is mixed with a sufficient quantity of water and the liquid is allowed to flow over nearly level tables, frequently 100 feet long, where the starch settles out of the liquid and the gluten passes on. After a sufficient quantity of starch is settled out it is removed from the table and dried in kilns. The starch is then broken up, ground, and put upon the market as either laundry starch or edible starch, known as "corn starch." The starch prepared in this way, while still moist, may be suspended in water and used as the basis for making glucose and grape sugar. (See p. 122.) The gluten which flows off from the starch is allowed to settle, then dried and put upon the market as "gluten meal" and from it a food-stuff suitable for human consumption can be manufactured.

Potato Starch

Maine and Wisconsin are the principal states where starch is manufactured from potatoes. The culls are used for this purpose and are purchased at from one-third to one-half the cost of the marketable potatoes. The process of manufacture is quite simple and in fact is one than can readily be imitated in the household. For this purpose the potatoes, after being peeled, are grated upon an ordinary tin grater, the pulp is pressed through cotton cloth and the milky liquid which runs through is allowed to stand over night when the starch settles to the bottom of the vessel and after

ully pouring off the liquid and washing several times by decan-
n, the starch can be taken out and dried.

or manufacturing potato starch on a large scale[1] the potatoes
rst washed, then put in a scraping machine which consists of
oden drum upon which are nailed pieces of sheet iron punched
f holes, with the rough edges facing outward—in fact, a sur-
practically like the ordinary grater. This drum revolves
ly and the potatoes being held in place at the bottom of the
er by a brace of hard wood, are quickly reduced to a pulp,
n is carried along by a stream of water which flows into the
er.

rom the scraping machine the pulp runs on to a starch sepa-
, which consists of a rectangular box, having wire gauze on
ottom with openings about 1/60 of an inch in diameter, and
ranged that it can be shaken like a sieve. This separator
ghtly inclined and as the pulp is carried in with water and
ed with jets of water, the attached starch granules are washed

Cassava Starch

While the chief use for cassava may be in the preparation of tapioca (p. 158.) and flour, it is becoming valuable as a commercial source of starch. The fresh roots contain from 24 to 28 per cent. of starch.[1] By the process used the factories can only secure about 20 per cent. of starch from the roots and a considerable quantity remains in the refuse, which is utilized for cattle food. The cassava grown in sub-tropical regions, as in Florida, does not contain as much hydrocyanic acid as that grown farther south.

In the manufacture of starch from cassava, the same machinery and method is used as with potatoes (p. 61). As the per cent. is larger in cassava, the yield of starch is greater than from potatoes. A few factories in Florida and Mississippi are engaged in this industry. It has been recently pointed out[2] that cassava is a much cheaper source of starch than corn or potatoes. In Florida the corn grown on one acre will produce 1200 pounds of starch, while the cassava grown on the same area will produce 5600 pounds of starch. At present the Southern product is practically all purchased by cotton factories where it is used for sizing and laundry purposes.

Microscopic Examination of Starch

To distinguish between the starches from different sources it is necessary to use a good microscope, and a "polarizer" is a convenient attachment. The grains from different sources when measured will be found each to have a different size, and will each have a characteristic appearance when viewed by normal and by polarized light. (Fig. 11.) It is by these tests that it is possible to detect the adulteration of an expensive starch with a cheap product, and to detect substitution, as for instance the mixture of corn flour with buckwheat flour.

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[1] U. S. Dept. Agri. Farmers' Bull. No. 167.
[2] Jour. S. Ch. Ind., 22, p. 63.

Digestibility of Different Starches

any investigations have been carried on upon the digestibility arches from different sources.[1] Raw starch digests much slowly than starch in the form of paste. "Potato, arrowroot

1

2

change occurs very slowly. . . . . However, in the case of starch still inclosed in cellulose walls, as in many starchy foods, the long-continued cooking may be necessary. The commercial preparations of corn starch require 30 to 40 minutes cooking because of the improvement of flavor which results."

Without going into detail in regard to the digestion of starch, it is known that the starch is acted upon to a small extent by the ferments of the saliva, but starch digestion takes place largely in the small intestine. Here the amylopsin from the pancreas, and the lactase, maltase and sucrase in the intestinal secretions act on the carbohydrates, and prepare them for absorption.

CHAPTER III

BREAD AND OTHER CEREAL PRODUCTS

BREAD AND BREAD-MAKING

History

making edible foods from the cereals or their products, us methods for grinding the grain, for making the dough and for baking have been in use from the earliest times. In rimitive stages of the civilization of all peoples, their methods been very crude and imperfect, but as bread of some kind has ng been the most important food of the race, the improve-become sour, would be to add some of the sour dough or "leaven" to the fresh batch of dough to induce fermentation. Thus it is evident that the whole process would be gradually evolved through experience.

The making of bread is possible because of the presence of gluten in the flour. Gluten is a protein or mixture of proteins, which becomes viscid or sticky when mixed with water, and this mass may then be blown up with air or any other gas, and finally the mass *sets* in this condition in the process of baking. If the walls of the cells are not stable enough to stand, when the gas has been expelled by heat, the bread falls, or is said to be heavy.

Unleavened Bread

Unleavened bread is prepared by simply mixing the ground, crushed or bolted flour with water and salt and baking before a bonfire, in the ashes, or on a pan in the oven. No attempt is made at "aeration" or making the product light. The Passover cake of the Isrealites, sea biscuit, and hard tack as used on shipboard and in the army, the Scotch oat cake and the corn-meal "pone" are examples of this kind of bread. Crude ovens built of clay are often used in baking these unleavened breads. (Fig. 12.) Graham flour and whole-wheat flour are often prepared in this way in dietary establishments, and these products require very thorough mastication.

"Biscuit" as they are sometimes called, or "crackers," are made either from the leavened or the unleavened dough. (See p. 75.) "Hard tack" is rapidly baked, and while in the oven the generation of steam and the expansion of the starch causes it to rise slightly. After being baked it is stored in a warm room for a week or two to "cure" and dry, and in this condition, will, if dry, keep for years without deterioration. Under the influence of heat and moisture dextrin is formed and the starch granules swell so that gelatinous starch is formed.

Not only will unleavened bread keep for a long time, but another advantage is that as it is so hard and dry it requires thormastication and will when eaten become mixed with large tities of saliva which aids digestion. This variety of bread is however, usually considered very appetizing, and so for al use it has never taken the place of raised bread.

growth of the yeast plant would be sufficient, if saved, to supply 400,000 persons with bread. Baking powders and other chemicals are some of the results of these experiments that are more or less satisfactory. They are used especially in the preparation of tea biscuit, cakes, pastry and foods of that character. These methods depend on,

(a) Entrapping of air, and expansion of water.

(b) Addition of a volatile substance to the dough;

(c) Addition of substances which break up and yield a volatile gas.

(a) Entrapping of Air

1. When Graham flour or fine flour is mixed with water or milk and beaten vigorously for some time, and then quickly baked in cast-iron pans, a fairly light bread results. Some air is enclosed in the batter to puff it up, and make it light, but the formation of steam from the water in the mixture is chiefly responsible for this result. The "beaten biscuit" of the South are made by the use of flour and water or milk, shortening and salt. The dough is beaten, rolled or pounded and frequently folded over until it incloses air blisters, which expand on baking.

2. A modification of this process is used in making pie crust. The lard or other "shortening" is intimately mixed with the flour and water and the dough on being kneaded incloses some air. The dough being somewhat laminated, the particles of flour are isolated the one from the other by the fat, and during baking the air and moisture expand thus making a light flaky dough.

3. This plan may be modified by mixing snow with the flour, and baking quickly. The snow crystals retain considerable air, which expands in the oven and makes the dough somewhat light.

4. Eggs, when beaten to a froth, are well calculated for retaining air, and this mass when mixed with flour has sufficient tenacity so that a large amount of air is mixed with the dough. Sponge cake and angel food cake are made light by the use of eggs alone without any other aerating agent.

(b) Addition of a Volatile Substance to the Flour

If an alcoholic liquor, somewhat diluted, is mixed with a when this is baked, the expansion and volatilization of the ol at the temperature of the oven, will raise the dough. It bable that very little alcohol remains in the finished product.

Aerated bread was invented in 1856 by Dr. Dauglish, an shman. It seemed for a time that it would replace other of bread in the United States, but for some reason, probably count of the lack of the yeast flavor to which we have become tomed, or because there is no peptonization of the proteins, read is not made in the United States in any quantity. It is, ver, used extensively in England. It is made by stirring her in a strong iron mixer, the flour, salt and water necessary batch. The water used is first impregnated under pressure carbon dioxide gas, and is in reality the same as the "soda " of the drug stores. The carbon dioxide is obtained from eer vats at the brewery, and compressed in steel cylinders for

7. When ammonium carbonate is decomposed by heat the following reaction takes place; $(NH_4)_2.NH_2HCO_2CO_3 = 3NH_3 + H_2O + 2CO_2$. If this salt in the form of a fine powder or in solution is mixed with the flour, in the process of baking it is decomposed, and the NH_3 and CO_2 gas set free raises the dough. Sometimes this salt, in addition to yeast, is added by the baker to make a lighter and consequently larger loaf, or it may be added to overcome the sourness of bread which is produced by overfermentation. The bread is, however, usually dry and tasteless.

8. Sodium bicarbonate ($NaHCO_3$), when heated, gives off a part of its carbon dioxide and some water, and the escaping gas raises the dough. In this process, however, there remains in the product the neutral sodium carbonate, which is an alkaline substance and renders the bread unwholesome. The reaction is $2NaHCO_3 + \text{heat} = 2Na_2CO_3 + H_2O + CO_2$.

(c) By the Addition of Substances Which Uniting Chemically in the Dough Set Free Carbon Dioxide Gas

9. When hydrochloric acid is added to sodium bicarbonate ($NaHCO_3 + HCl = NaCl + H_2O + CO_2$), carbon dioxide is set free and sodium chloride or common salt formed. This reaction has been taken advantage of, and is utilized by mixing baking soda with the flour and adding the required quantity of dilute acid to the water used in mixing the batch.[1] Great care is required to use exactly "equivalent" quantities of these chemicals. The flavor of this bread has not proved very satisfactory. The process has been used especially in making Graham bread, bran bread, and whole wheat bread in dietary establishments. Jago[2] believes that bran bread made by this process is not a wholesome product.

10. By the use of baking soda and molasses, it is possible to obtain an excellent product, if care is exercised in using the right proportions. The molasses contains some free acid or acid salts which act upon the baking soda and set free the carbon dioxide,

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[1] The Science and Art of Bread-making, Jago, p. 401.

[2] Ib., p. 402.

ıg a neutral salt of the acid in the product. Gingerbread is times made by this process. In case the molasses is not iently acid, a little vinegar may be added to it before mixing. ›rdinary cooking molasses now on the market does not usually in a large amount of acid, and is entirely different in quality the "New Orleans" molasses of fifty years ago.

. A light and wholesome product may be obtained by the f baking soda and freshly curdled sour milk. In this case is left in the bread, sodium lactate, a harmless salt, and n dioxide is set free as in the other cases. One teacup of milk will usually neutralize one-half a teaspoonful of baking Here again a little vinegar may be used to render the milk acid, but it is better to use less soda in neutralizing. Cakes iscuit are not only raised by this process, but they are made r and more nutritious by the fat and the casein of the milk. cess of baking soda, renders the product yellow and unwhole-. The chemical equation representing the process is:

"acid" substance is either cream of tartar (sodium bitartrate), tartaric acid, calcium phosphate, sodium phosphate, or alum, with the addition of not over 30 per cent. of starch or in some countries rice flour as a "filler." The starch would not, unless in excess, be regarded as an adulterant, as it is used to prevent the chemicals from combining during the storage of the powder. While the chemical change cannot take place when all the materials used are *perfectly dry*, when they are moistened, as in the making of bread or cake, the chemicals react, and carbon dioxide gas is set free. Baking powders are sometimes found on the market without any "filler," but they are not well adapted to keeping for any length of time.

A good baking powder can be made by mixing 2 pounds of baking soda, with 4 pounds of cream of tartar, and a little less than 2 pounds of starch. Mix the soda and the starch first, then after adding the cream of tartar, mix very thoroughly. It is absolutely essential that the ingredients be *perfectly dry*. In cream of tartar baking powders, some of the cream of tartar is often replaced by tartaric acid, but when this is done the chemical reaction takes place more rapidly, and therefore may go too far before the dough is placed in the oven.

In the case of the phosphate powders, the residue remaining in the bread consists of acid calcium phosphate ($CaHPO_4$) and acid sodium phosphate (Na_2HPO_4). When alum is the "acid" chemical used, there remains in the bread sodium sulfate (Na_2SO_4) potassium sulfate (K_2SO_4) or ammonium sulfate ($(NH_4)_2SO_4$) and aluminum hydroxide ($Al(OH)_3$). Instead of a soda alum frequently "burnt alum," aluminum sulfate, or what is known in the trade as "C. T. S." (the calcined double sulfate of sodium and aluminum) is used. It is considered by many manufacturers advantageous to use a mixture of alum and acid calcium phosphate. An acid sodium sulfate ($NaHSO_2$) with sodium bicarbonate is also used for making baking powders. Quite recently small quantities of albumin have been introduced into some brands of baking powder. Although such a powder would r to produce more foam when dissolved in water there seems no good reason for supposing that the leavening quality of oduct is improved.

Wholesomeness of Baking Powders

ich controversy, stimulated often by rival manufacturers, isen in regard to the wholesomeness of the residue remaining ad made with different kinds of baking powder. Rochelle ft in the product by the use of cream of tartar baking powhas somewhat of a laxative effect. A loaf of bread would n even more of this salt than is found in a Seidlitz powder,[1] e amount present in the bread consumed at a single meal is ll that its effect on the system can be practically disregarded. case of the phosphate powders the sodium phosphate left, s a mild purgative in doses of from 1 to 2 ounces which is, er, much more than would be found in the bread used at one baking powders, or those which have not been well dried, or which have not been well enough packed to exclude moisture, are usually so deteriorated as to be of little or no value. The Federal Standard and that adopted in many States is to require that a certain amount of carbon dioxide gas, be given off when water is added to the powder; this standard will exclude old baking powders. The average amount of carbon dioxide which baking powders yield is 60 cubic inches per ounce.[1] It has been found that a standard requirement of not less than 12 per cent. of available carbon dioxide is fair and will protect the consumer against goods which have been in stock for a long time and so are practically of no value. In any case the composition of the powder should be printed on the abel. The amount of baking powder used in the United States s much larger than in other countries.

II. Bread Raised by Fermentation

In raising bread by the process of fermentation, there are three methods:

1. *By the use of leaven.*
2. *By the "salt-rising" process.*
3. *By the use of yeast.*

1. It was found a long time ago that if some of the dough from one baking be set aside, it could be used as a "starter" for the succeeding batch. Care should be taken that the dough is not kept in too warm a place, lest a disagreeable taste be communicated to the bread by excessive souring. As the yeast cells already exist in the air, and will readily grow when they fall into a proper medium, it is possible to raise bread without the addition of yeast. If, however, we depend upon getting the yeast from the air, other organisms are liable to be mixed with the yeasts, and they will produce acids such as acetic and lactic, and the dough will be sour. This sour, fermenting dough was no doubt the first used and was

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[1] Mallet, Chem. News, 1888, II, 276.

ps the original "leaven." Since the introduction of baker's rewer's yeast and dry and moist yeast cakes, this process has ittle used. It finds favor chiefly for raising bread made from nd other coarser bread stuffs and is known as the "Sauerteig" od. The black, sour "Pumpernickel" and the "Schwartz-' used in certain parts of Germany, are made in this way.

The salt-rising process utilizes the fact that there exist in neal, flour, milk and other ingredients used in making bread, n bacteria which can be encouraged to grow and multiply a fixed temperature, which temperature effectually kills other organisms. It has been shown by H. A. Kohman,[1] true gas-forming bacteria will grow under the conditions lent in making salt-rising bread, and the gas produced out two-thirds hydrogen and one-third carbon dioxide. as also found it practicable under the right conditions of temure, and in a suitable medium, to isolate these bacteria. special variety can be dried and put upon the market as a

Bread made by the "leaven" process differs from that made by the "salt-rising" process, in that the former owes its leavening power mainly to yeasts, while in the salt-rising process it is due to gas-forming bacteria. The loss of materials, due to the decomposition and volatilization of some of the constituents of the flour is much less in salt-rising bread than in that raised by yeast. The former variety has a fine grained texture and a characteristic odor that is by some considered disagreeable.

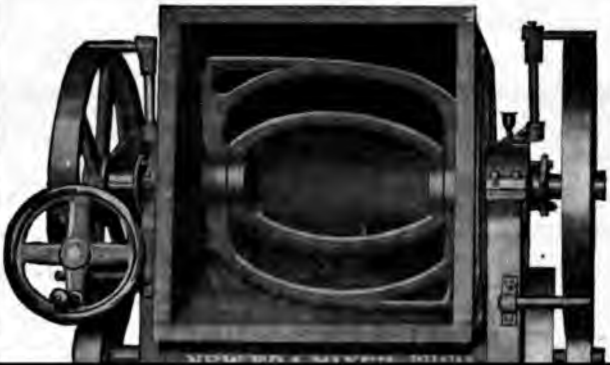
3. In making bread with yeast in the United States, there are three general processes used: first, the sponge, and dough method; second, the ferment and dough method; third, the straight dough process.

In the sponge and dough method, the sponge consists of a batter composed of flour, water and yeast, these being mixed in the evening and allowed to stand till the next morning when enough flour is added to make a dough of the proper consistency, which is kneaded and finally put into the pans. The advantage of this method is that the sponge is prepared in the evening, and worked the next morning, and also only about one-third as much yeast is required as in the straight dough method.

In the ferment and dough method, a potato ferment is frequently used by small bakers and housewives. This is prepared by cooking potatoes, cooling, mixing with yeast and flour and allowing the mass to ferment. It is then added to flour and water, made into a dough of proper consistency and handled as in the sponge and dough method.

In the straight dough process, which is most extensively used in all large bakeries, the materials, flour, water or milk (sugar), malt, lard, and yeast are all mixed at the same temperature. Considerable yeast, even as much as 1 per cent. is used. Only one mixing is required in this process, and not so much handling. The flour is first sifted and blended by running through silk bolting cloths. This process has the added advantage of breaking up the particles of flour which have become closely impacted together and at the same time two or three flours of different types may be

ed. For instance, Minnesota flour which is lighter in color ed with a Kansas or Illinois flour, which is stronger in gluten. the blending process, which is usually carried on in the lower of the bakery, the flour is elevated to the mixers. These are anged that the solid materials can be weighed upon a scale, automatically controlled, and the amount of water used can



thorough mixing of all the ingredients. One thousand pounds of dough can be handled at one time. (Fig. 14.)

After it is mixed, the dough is put into a rectangular wooden box called a "trough" (tro) in the fermentation room and allowed to stand. The temperature of this room, which is commonly about 80° F., is so regulated that it never varies more than one or two degrees. In the summer refrigeration keeps the temperature down, and in the winter the room is warmed. It is very important to regulate the temperature of the dough before it goes into the fermentation room, as such a large mass of dough will hold its temperature for five or six hours.

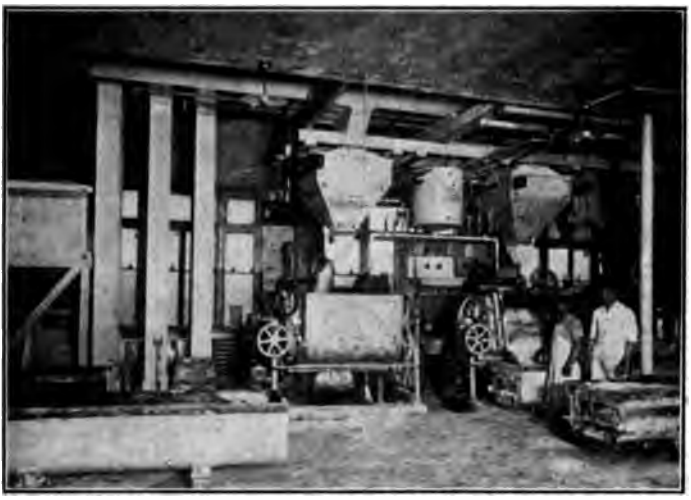


Fig. 14.—Bread mixing room equipped with automatic scales for flour and water as seen above mixers. Brunner Baking Co., Buffalo, N. Y.

In recent years the period of fermentation has been much reduced so that instead of requiring ten hours as formerly, five or six hours are sufficient. In order to do this more yeast, and that of a stronger variety is employed. During fermentation the dough is worked by hand three times, allowing the gas to escape and bringing the yeast in better contact with the dough. The carbon

e gas which is given off, if allowed to remain in the dough
s the fermentive power of the yeast.

dough is next "scaled" off into loaves of the required size
achine especially designed for this purpose, so as to secure
m weight for the loaves. After "scaling" it goes through
ocess called "rounding," after which the bread is allowed to
for about fifteen minutes to rise. The dough is then put into
olding machine and molded into the desired loaf. These
are again allowed to rise in the pans and this process is has-
by keeping the temperature as high as 100° F. in steam boxes.
eam at the same time moistens the top of the loaf and pre-
its drying out. Some of the materials used by modern bak-
, powdered milk, which has the advantage of keeping inde-
y; compressed yeast; cotton-seed oil; malt extract, which
et and communicates a characteristic flavor to the bread,
hich contains diastase, a substance which greatly assists
ocess of fermentation.

in the United States until the introduction of stoves about 1850, and which are still in use in many foreign countries, and even in large baking establishments, the fire is built in the oven, and when the fire brick of the floor and the arch have become thoroughly heated, it is withdrawn, and the ashes removed. Bread and pastry may then be baked in this oven for several hours before the heat is exhausted. The process has the advantage of giving a uniform heat, and when the oven becomes too cold, a little additional fire will soon again raise the temperature sufficiently for baking.

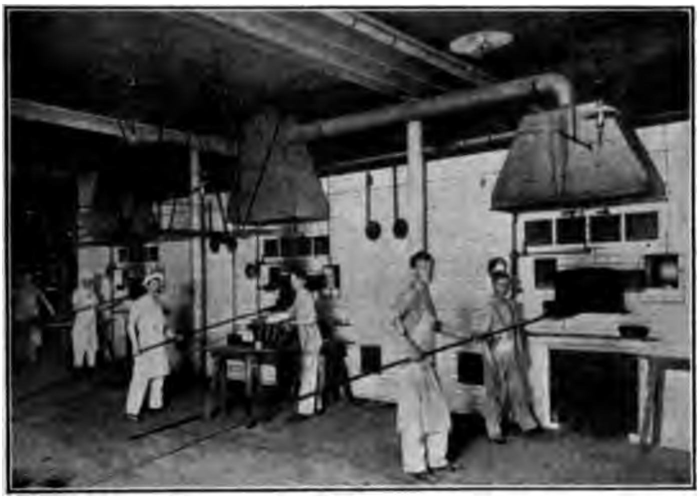


FIG. 15.—Peel oven, Brunner Baking Co., Buffalo, N. Y.

The "baking effect," is due to the radiation from the walls, and on this account the character of the walls deserve special study. They should be black to secure the maximum radiating effect.

Yeast and its Action

The yeast plant requires certain definite conditions of temperature nutrition and moisture for its growth. It is a monoc organism which grows or multiplies by a process of buddi

upon sugar and similar materials in saccharine or starchy
nces. It also requires and uses in its growth nitrogenous
rtain mineral constituents especially potash and phosphoric

e variety of yeast best adopted to bread making is said to
ccharomyces cerevisiæ, which, acting perhaps indirectly,
about the change of starch to sugar, thus: $C_6H_{10}O_5+$
$C_6H_{12}O_6$; and the change of sugar to carbon dioxide and
l, thus: $C_6H_{12}O_6=2C_2H_5OH+2CO_2$.

**is most active between 70° F. and 90° F., and is destroyed if
mperature is raised to 131° F. If the yeast plant does not
vigorously in the medium a sour and unpalatable bread will
, as other substances, especially those having acid properties,**
ave been produced. In the use of potatoes for making the
e the baker has learned to use a medium which is rich in pep-
tyrosin, asparagin and other protein bodies, which are power-
muli of enzymic action. Rye flour added in small quantities
eat flour assists fermentation perhaps because it contains

meal, making into cakes, and drying at a moderate temperature. Although this yeast acts slowly, it will keep for a long time in a dry place. It is said that yeast cakes were used by the Romans in the first century.[1]

Chemical Changes Produced

It is of interest to note what changes besides the production of carbon dioxide gas and alcohol actually take place in the making of bread. The gluten already referred to as a constituent of wheat flour (p. 64) is composed of the two substances gliadin and glutenin. Gliadin is the substance which binds the flour particles together to form the dough, and gives it tenacity and adhesiveness, while glutenin is the material to which the gliadin adheres.[2] These two substances must be present in the flour in the right proportions if the flour is to have the highest bread-making properties. Wheat flour contains only small amounts of albumin and globulins, and these are rendered insoluble by the action of heat in baking.

The proportion of protein is, however, but little altered in the process of bread-making, although some of the soluble proteins have been used up by the yeast. The slight losses of both nitrogen and carbon compounds that may take place during the process are more than offset by the increased solubility and digestibility of the proteins and carbohydrates in the finished product.[3]

The fat contained in the flour is slightly oxidized and changed in color in bread-making, similar to the process called "aging" which takes place in flour during long storage.

During the alcoholic fermentation, about 1 per cent. of carbon dioxide and an equal weight of alcohol are produced, and volatilized in baking. The soluble carbohydrates are those which are acted upon by the alcoholic ferments. The yeast plant also secretes soluble ferments which act upon the starch to form soluble carbohydrates. About 10 per cent. of the starch is changed to luble forms known as dextrin-, dextrose-, and sucrose-sugars. rown coating or dextrin on the surface of the loaf of bread, duced mainly by the action of heat upon the starch. Al- h dextrin still has the composition represented by the symbol $_0O_5)_n$ it has different physical properties from starch and e readily digested.

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[1] Tibbles, p. 403.
[2] Human Foods, Snyder, p. 169.
[3] Loc. cit.

way of comparison the following table given by Snyder[1] the composition of flour, and bread made from it in different

Material	Water, per cent.	Protein, per cent.	Fat, per cent.	Carbo-hydrates, per cent.	Ash, per cent.
....	10.11	12.47	0.86	76.09	0.47
rom flour and water....	36.12	9.46	0.40	53.70	0.32
rom flour, water and lard	37.70	9.27	1.02	51.70	0.31
rom flour and skimmed	36.02	10.57	0.48	52.63	0.30

Bibra maintains that fresh bread contains free water some of which unites with the starch and gluten as the bread becomes stale. M. Lindet[1] has shown that as the bread becomes stale a part of the starch which was transformed into amylodextrin, returns at the end of twelve to twenty-four hours to the state of starch. By reheating it is claimed that some of the amylodextrin reappears, and thus the bread again has the characteristics of fresh bread. Williams[2] believes that when the bread becomes stale the fibers shrink and the cell walls become more compact or solid, and that reheating causes the moisture to be given off and the cell walls to expand so that the bread appears to be more porous.

Toast

When bread is toasted, some of the starch changes to dextrin which is more soluble than starch and also more easily digested, but the proteins are rendered less soluble, and hence slightly less easily digested.[3] Toasting causes the bread to yield more readily to the action of diastase and other ferments, and at the same time tends to sterilize the bread and kill those ferments that were not destroyed in the process of baking.

In order to obtain the best results from the use of toast it should be toasted so that it is crisp throughout. This is attained in the "rusk" which is put on the market by the large bakers, and in the "zwiebach" of the Germans. Both these products are valuable food, especially for dyspeptics, as they furnish abundant nutriment which is easily available, and complete mastication is necessary.

Some Causes for Bad Bread

Bread, although it has been subjected to the heat of the oven is by no means sterile. It presents an excellent medium for the growth of various molds and bacteria, the germs of which were in our or other materials used. The sourness of bread is due development of lactic, butyric and acetic acids, whenever onditions become favorable for the growth of the ferments produce them. If the fermentation is carried too far in ort to get a large loaf of bread out of a small amount of flour, he temperature of fermentation is too high these acid-forming isms get the upper hand, and sour bread results. The best s sacrifice a little *bulk* for *quality*, and produce a non-acid with a sweet, agreeable, nutty flavor, a product which is wholesome and palatable.

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[1] Bull. Soc. Chim. d. Paris, XXVII.
[2] Chemistry of Cooking.
[3] Minn Ex. Sta. Bull. No. 47.

Ropy bread" is due to the growth of spores of an organism, is found especially in potatoes. The heat of the oven does estroy these spores in the interior of the loaf, so that in moist, weather they develop there and cause the crumb to become , and sticky, and have a disagreeable taste and odor. Molds ious colors grow on bread as it increases in age. One of these illium glaucum), the bluish-green mold, is active in the ripen-flour other than wheat.[1] "It is evident that we must depend upon wheat in a large measure, for the texture, lightness and flavor of our bread, but that wheat has no unique nutritive value. The demand for wheat bread represents a habit of mind and palate, rather than any non-replacable need." Any of the substitutes can be used, and they vary only slightly in nutritive value as represented by the number of calories yielded.

Varieties of Bread

In addition to white bread many other kinds are used in different countries, and prepared commercially: "Graham" bread (see p. 30) and entire "wheat" bread are shown by chemical analysis to contain more protein than that made from the patent flours.[2] According to digestion experiments, however, the proportions of digestible or available protein and available energy in the patent flour are larger than in either the entire wheat or the Graham flour. The lower digestibility of the protein is due to the fact that in the coarse flours, a considerable portion of the protein is covered up inside the bran particles, and so resists the action of the digestive juices. The advantage of the use of these coarse breads due to their stimulating the activity of the bowels, should not be forgotten.

Vienna rolls which have a crisp exterior, and a large amount of dextrin, are a common food on the Continent of Europe, and to some extent in other countries. They are made from a high grade of flour with a large proportion of yeast. They are baked in an atmosphere of steam under pressure, and thus the water on the surface of the rolls gelatinizes the starch and gives a glazed appearance to the rolls. This is sometimes imitated by brushing the surface of the rolls with egg albumen before baking.

Other forms of bread are rolls, which are raised with yeast, and contain sugar, and "shortening"; milk rolls which are mixed with milk instead of water; muffins, made by the use of baking powder,

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[1] Elizabeth C. Sprague, Am. Food Jour., Vol. XII, p. 273.
[2] U. S. Dept. Agri. Exp. Sta. Bull. No. 101.

rd, and rapidly baked in an iron pan; Scotch scones, made
ncakes and baked on a hot plate. German pretzels are
rom a dough raised with yeast, and just before baking the
re plunged into boiling water in which oat straw is soaked.
salting heavily the pretzels are baked quickly, and then
d to cool slowly in a warm oven. The use of flour other than
in bread making is an adulteration, unless the bread is sold
proper label stating its composition.

la crackers or "biscuits" as they are often called are made
raised dough which is "shortened." The dough is kneaded
lled by machinery, and the crackers are usually baked in a
ing oven over a quick fire of anthracite or coke.

Adulteration of Bread

account of the importance of bread as the "Staff of Life,"
thorities have in all countries kept a sharp watch for adul-
ns. As flour has gone higher in price, or as the cupidity of

White bread has a fuel value of	1200 calories per pound
Brown bread has a fuel value of	1040 calories per pound
Graham bread has a fuel value of	1195 calories per pound
Whole wheat bread has a fuel value of	1130 calories per pound
Rye bread has a fuel value of	1170 calories per pound
Crackers	
Cream crackers have a fuel value of	1925 calories per pound
Soda crackers have a fuel value of	1875 calories per pound

The fuel value corresponds quite closely to the food value, except that, as previously stated, some foods are more completely digested than others.

Experiments made both on men and on dogs by Mendel and Fine[1] indicate that "'gliadin' gluten and the two characteristic proteins of wheat gliadin and glutenin are as thoroughly utilized as the nitrogenous components of fresh meat."

Foods Complementary to Bread

As bread, for a perfect food, is somewhat deficient in protein, it is commonly supplemented by the use of meat, cheese or some legumes such as beans. As it is deficient in fats, we use butter or "gravy" to supply this need. Since there is not sufficient lime in the wheat products, they are often supplemented by the use of milk. Bread and milk, especially if "whole milk" is used, has long been considered an excellent food, especially for children.

ALIMENTARY PASTES

Macaroni, which is made from hard wheat, is a preparation of a glutinous character, the manufacture of which is made possible by the presence of a large amount of gluten in wheat flour. It is drawn, molded or stamped into various forms, known in the trade as macaroni, vermicelli, spaghetti, noodles, Italian paste and similar products. The largest quantity of macaroni wheat is raised in southeastern Russia, from which country at least 25,000,000 bushels are annually shipped to Italy and France for the manufacture of macaroni. Durum wheat, which has p been referred to, is well adapted for making macaroni. It well in semi-arid regions, where the conditions are great nes of temperature with a small rainfall, but so distributed good proportion of it falls during the growing season.

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[1] J. Bio. Chem., Vol. 10, p. 324.

Material Used

r the manufacture of macaroni[1] in many localities the granu- ur specially prepared for this purpose, and known to the ns as "semolina" or "smola" is used. The wheat, which be first thoroughly cleaned and washed, after drying is again ened before grinding so that the bran obtained may not e mixed with the flour. The ground product is then passed gh sieves of different degrees of fineness. From this process results about 65 per cent. of semolina, the coarsely ground ct, and 17 per cent. of flour.

molina is a favorite food in some localities of France and nd. The millstones in which it is ground, are grooved so product desired. Within the pan travels a stone wheel, and as it is made to move slowly around the pan, the dough is thoroughly mixed. This operation requires at least thirty-five minutes. The dough is then passed into a perpendicular hydraulic steel press, called in Italy a "trafila," the bottom of which consists of a bronze die perforated with holes, and in the center of each hole is a pin attached to one side. This pin forms the hole in the macaroni, and although it divides the dough as it enters the hole, it comes together as a perfect tube when it leaves the bottom of the die. A piston forces the dough into strings or tubes which are afterward cut into pieces about 3 feet long, hung on racks, in the sun, for two hours, and cured at a temperature of 70° F. (Fig. 17.) After this preliminary drying the product is stored for twelve hours in a cellar to allow the moisture to become better distributed, and then again dried for several days in the open air, or more quickly in a current of air in a properly constructed chamber.

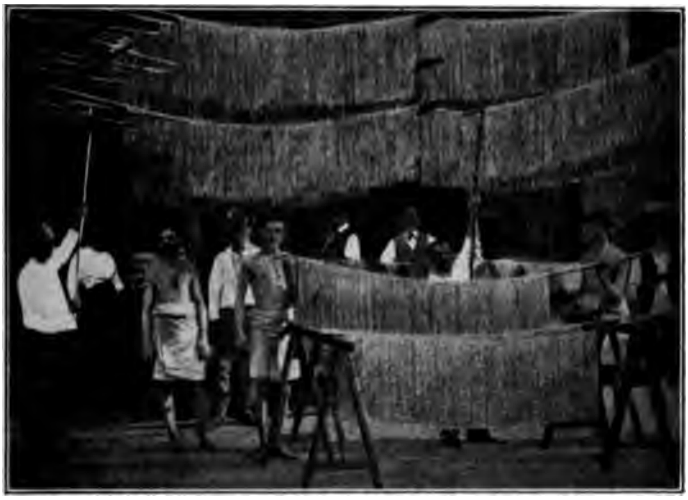

FIG. 17.—Drying macaroni in Italy.

The name "vermicelli" is applied to the smaller rods. A

variety of Italian "pastes" as they are called, are put upon
ıarket. The genuine macaroni is translucent in appearance
s so tough that it will resist considerable rough handling
ut breaking. It may be called the National Italian food.
18.)

	Typical wheat	Genuine macaroni	Italian macaroni from Kans. hard wheat
Moisture	10.60	10.05	10.36
Protein	12.25	13.06	12.06
Fat	1.75	0.24	0.38
Ash	1.75	0.65	0.51
Carbohydrates, by difference	73.65	75.50	76.12
Crude fiber	....	0.50	0.57

The amount of macaroni, vermicelli and similar products used in the United States is constantly increasing; this is partly on account of their use by the immigrants who come from southern Europe, and to quite a large extent because a taste for this food is being cultivated here. No less than 902,551 pounds of these products were imported in 1919.[1] A large amount of macaroni and other "pastes" are now made in the United States.

BREAKFAST FOODS; PROPRIETARY FOODS

Within the past twenty years there has arisen a demand for specially prepared food, which offers a concentrated form of nourishment and which may be readily prepared for the "hurry up" American breakfast. The number of these is legion, and their beneficial properties have been heralded in the advertising pages of newspapers and magazines and on the bill boards.

The breakfast foods are made mostly from wheat, corn, oats, barley and rice with an occasional addition from other sources, and their food value is often grossly misstated by the manufacturers. These foods may be divided into the three classes:

1. *Raw cereals* prepared by crushing the grains to different degrees of fineness after decorticating.
2. *Partially cooked* preparations from these grains.
3. *Malted cereals*, in which the moist grains are ground and mixed with malted barley, so that a portion of the starch is con-

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[1] Bull. Dept. Commerce Dec., 1919.

d into maltose and dextrose, after which the mixture is ed between hot rollers and dried.

Composition

he following selected analysis may be considered:

Name	Moisture	Protein	Total carbohydrates	Crude fiber	Fat	Ash
ns breakfast food[1]	9.51	10.56	76.96	2.01	1.45	1.52
[1]	9.72	15.10	71.75	1.55	1.90	1.53
d wheat[1]	9.30	12.60	74.42	1.49	2.22	1.46
oats[1]	7.40	17.20	66.65	1.40	6.08	1.67
ts[1]	8.07	17.74	65.89	0.99	6.52	1.78
ne (from corn)[1]	9.55	9.90	78.75	0.72	1.24	0.56
of wheat[2]	10.69	11.75	76.17		0.95	0.64
Pillsbury's)[2]	8.74	12.69	76.56		0.98	1.03
na[2]	8.41	11.50	75.23	1.03	2.10	1.73
ck[1]	10.64	14.31	68.87	4.21	0.49	1.48
nuts[1]	8.00	12.73	73.78	2.02	1.57	1.90

As a result of digestive experiments with some of these malted products,[1] although the converting action of the malt had changed a fair percentage of the starch to reducing sugar, yet the nutritive material contained is about as digestible as that of rolled wheat, although the process has at the same time rendered the protein less digestible. A far larger proportion of the starch in these malted products remains unchanged, than that which is converted by the action of the malt. The analyses show that the statement, that the starch is eliminated in the process of preparation and therefore the breakfast food is especially valuable for the use of dyspeptics, is untrue. After all is said a product made from wheat or corn or oats will not be very superior to its *source* in nutritive value.

It is urged in defense of the use of prepared breakfast foods sold in packages that they are less liable to accumulate dust and dirt, than those sold in bulk. This is in general true, and this method of sale is an advantage especially when "individual" packages are served on the table; but there is an opportunity for the grocer to store unsold packages, for a long time and these are sometimes found to be infested with worms and insects, and to be absolutely unfit for use.

While these foods contain considerable crude fiber which diminishes their nutritive value, this may on the other hand render them more wholesome to the average person. There is also a question whether a partially digested food, is really desirable for the person with normal digestion.

On account of the almost universal use in the United States, among all classes of these "easy to prepare" foods, the question of economy should not be overlooked. The price of bread stuffs is at present abnormal, but some years ago it was found that the retail price per pound of these breakfast foods was as follows: Quaker oats, 7.3 cents; Nichol's pearl hominy, 5.3 cents; cream of wheat, 8.8; grape nuts, 17.1; shredded whole wheat, 20; force, 16.5; flaked rice, 18.2; granula, 27.2; Quaker corn flakes, 13.3; Kellogg's corn flakes, 20; maple corn flakes, 14.5; Post es, 18.4; grape sugar flakes, 17.8; malta vita, 18.4; sugar flakes, 20; Holland rusk, 22.8; puffed wheat, 27. At rates a bushel of wheat, costing originally $1.00, would when into breakfast cereals cost from $5.00 to $12.00. These indicate that the consumer was paying *luxury prices*, for ry nutritive foods. With the increased price of wheat and cereals there is still a similar comparison between the cost raw material and the retail price of the product.

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[1] Maine Agri. Exp. Sta. Bull. No. 118.

PANCAKE FLOUR (Self-raising flour)

order to still further decrease the labors of the household, e variety of self-raising flours have been placed on the t. These are, of course, only flour mixed with salt and bakwder. The analysis of a few typical brands is sufficient for rison.[1]

Name	Moisture	Protein	Starch, fiber ash, leaven	Fat	Total carbon

that are needed to nourish the system under abnormal conditions. These foods are either farinaceous, prepared from cereals, either cooked or malted, or from mixtures of cereals with milk products. The common fault of these foods is that they contain too much sugar and starch and not enough fat. The starchy baby-foods should never be given to a child under eight or nine months of age, as the secretions in the earlier months are entirely unfitted to digest such foods.[1]

Some of these are made up of baked dry wheat flour, sometimes mixed with the flour of barley or oats. The more soluble starch foods[2] are made by mixing ground wheat and barley malt with water to form a paste to which a little potassium bicarbonate is added. This mixture is heated at 65° C. for a sufficient time to convert the starch by the action of the malt diastase; the mixture is extracted with warm water, and this solution evaporated to dryness. This contains such sugars as maltose and dextrin.

In the preparation of the milk foods, whole or skimmed milk is evaporated to dryness and mixed with sugar or baked cereal flours. Desiccated milk mixed with a dried extract of malted cereals is also used.

Tibbles[3] has collected a very complete list of analyses of foods of this class. He says: Horlich's malted milk consists of desiccated milk 50; wheat flour 26; malt 23; soda bicarbonates 0.75 parts. Carnick's soluble food consists of dried milk 37.5; malted wheat 37.5; milk sugar 25 parts. Nestle's food consists of equal parts of dried milk, baked flour, and cane sugar, therefore much starch remains unchanged. Mellin's food is made of wheat flour, malt and carbonate of potash; it is digested by Liebig's process until all the starch is converted into dextrose and dextrin; it is then strained to remove cellulose, husks, bran, etc., and evaporated to dryness in a vacuum pan at 140° F. Ridge's, Neave's and Frame foods are baked flour in which some of the starch is dextrinized by heat.

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[1] Practical Dietetics, Thompson, p. 147, 759.

[2] Food Inspection and Analysis, Leach.

[3] Loc. cit.

hese foods are often compared in composition to human milk, it will be seen that they usually show too much starch and r. The patent foods in which the starch is unconverted, ss no advantages as additions to the diet of older children over simple articles as oatmeal, rusks, and rice, and the latter are h cheaper.[1]

Non-scientific Diet Systems

report[2] of the U. S. Department of Agriculture in regard to ments about many systems of diet recommended for com- ial profit, seems pertinent, in this connection. "Some of dvocates of freak diets are sincere, but are themselves deluded, others are fakers who seek to make monetary gain, by advis- eculiar systems of diet." One of these fads is the use of *raw* While there is no objection to the use of raw food by a per- f he likes it, and can prove that it agrees with him, yet as a al proposition man will stand a better chance to thrive if es *both* cooked and uncooked foods, in the ways that they

CHAPTER IV

SUGAR AND OTHER SACCHARINE SUBSTANCES

The desire for sweet substances seems to be universal in man and is not uncommon in the lower animals. The name sugar was at one time given to substances having a sweet taste, as sugar of lead, etc., but was later restricted to certain oxy-aldehydes and oxy-ketones, having the general formula $C_n(H_2O)_m$ which occur in the vegetable and animal kingdoms. The chief substances of this class from a chemical standpoint (see pp. 15–18) are:

Cane sugar ($C_{12}H_{22}O_{11}$).
Glucose ($C_6H_{12}O_6$).
Fruit sugar ($C_6H_{12}O_6$).
Lactose ($C_{12}H_{22}O_{11}+H_2O$).
Mannite ($(C_6H_8)(OH)_6$).

The important sources of sugar in nature are the sugar cane, sugar beets, sorghum or Chinese cane, sap of sugar maple trees, date palm trees, sap of ash trees of southern Europe, the bamboo, honey, raisins and milk of mammals.

History

The ancients were familiar with honey as the chief representative of this class of foods, although they also used sweet fruits. The first true sugar was prepared either from the juice of the bamboo or that of the sugar cane, and was probably first known in India.[1] It was very early introduced into China; the sugar cane was also cultivated in the valleys of the Euphrates and Tigris Rivers.

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[1] The Story of Sugar—Surface, p. 15.

t first sugar was used as a medicine, but gradually came to be ded as a luxury, and was partaken of only at special feasts. Arabia through Egypt and finally by the Moors, sugar cane ntroduced into Spain and the countries north of the Mediter- n Sea. In the fifteenth century cuttings were sent by the of Portugal for planting in the Madeira and Canary Islands. the latter country the sugar cane was introduced into Brazil in the sixteenth century, and then into the West Indies, ipally into San Domingo. It was not introduced into the ican Colonies until 1750 at which time an unsuccessful npt was made, to make sugar, in Louisiana. In 1791, how- the sugar boilers were more successful. The "ribbon or le" cane, which was better adapted to the soil and climate of siana was introduced in 1820 and since that time it has been ariety most extensively grown.

Iore recently new varieties have been introduced principally Demerara. These seedlings have been grown originally from produced by the cane, each seed being selected and numbered

The use of the beet for sugar making dates back to the experiments of Marggraff, a chemist in the University of Berlin,[1] who in 1747 was able to extract from beets only 1.5 per cent. of sugar; fifty years later Achard his pupil only extracted 3.0 per cent. This industry was greatly stimulated by Napolean I, and in 1806 a bounty was offered by the French government for sugar produced in France. In 1812 the production had increased so that 1650 tons of beet sugar was placed on the market; and the annual output of Europe in 1912 was over 8,000,000 tons. The raising of beets for the manufacture of beet sugar has become an important industry not only in France, but in Germany, Austria, Holland and America. The amount of sugar in the beet has been steadily increased by seed selection, better cultivation and adaptation to soil and climate until now it is not uncommon to find beets containing from 15 to 23 per cent. of sugar, although the average as produced in the United States is not more than 13 or 14 per cent. The beet is really richer in sugar than the sugar cane of Louisiana, which does not average more than 11 or 12 per cent. of sucrose.

Both cane and fruit sugar are found in numerous fruits; but the latter is the more abundant. Pineapples, contain 11.33 per cent. of cane sugar, strawberries 6.33 per cent., apricots 6.04 per cent., apples 5.28 per cent. (See table, p. 209.) These fruits it is true are not adapted for use in making sugar, but the sugar is available, as will be seen later, for the production of alcohol and vinegar.

Cultivation of the Sugar Cane

The sugar cane (saccharum officinarum), which belongs to the family of grasses, grows best in a sub-tropical climate where the plant is not in danger of being killed by an early frost, as it is very susceptible to a low temperature. It is most successfully cultivated in Cuba, the West Indies, Louisiana, the Philippine and Hawaiian Islands, Java, and Brazil. Although cane may be raised

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[1] Loc. cit., p. 110.

e the mean temperature is not below 66° F., it flourishes best
mean temperature of from 75° to 77° F. It should also have
dant sunshine and moisture. In fact, cane grows best where
is at least 50 inches of annual rainfall and where half of this
s in the growing season in the late spring.

s a large amount of mineral and nitrogenous food is needed
is crop it is evident that even the best soils will ultimately
hausted. This may be largely obviated by a careful rotation

crops are profitably gathered from one setting, and then new plants must be started. In many tropical islands, however, the sprouts from the old roots are cut year after year until the plants die, but profitable cultivation is only for from five to seven years from one planting. The cane is generally cut by hand labor, and is then hauled to the mill. (Fig. 15.) This hauling on the larger plantations in the United States, is done by means of special cars on a dummy railroad. The average cane production in the United States is 18 tons per acre.[1] In tropical countries good cane contains from 15 to 18 per cent. of sucrose[2] and the extracted juice contains under favorable conditions 17 to 18 per cent. of sugar. About 95 per cent. of the total sugar can be profitably extracted in the modern mills.

There is a particular stage in the growth of the cane in which it is said to be ripe, or to reach its maximum of sugar content, then as inflorescence proceeds the extractable saccharine matter decreases. It is therefore of importance to cut the cane at just the right time. In tropical countries cane does not reach its full growth or ripest stage under twelve to fourteen months. To extend the cutting season over as much time as possible, the cane is planted at different times during a series of weeks, and in the following season, harvested in the same approximate rotation.

In Louisiana, the life of the cane is shortened by cold weather to a total of not over nine months and in consequence, its sugar content is lower than in the tropics. A temperature of 28° F. will kill the cane and thus prevent further growth, and the deterioration of the crop after the frost is immediate.

MAKING CANE SUGAR

There are two general processes for obtaining the juice in making sugar; (1) by grinding or crushing the cane, and (2) "diffusion." The former process is the one usually applied to sugar cane, and the latter to sugar beets.

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[1] Ibid., p. 52.

[2] Cyclopedia of Am. Agri., Vol. 2.

ANUFACTURE OF SUGAR FROM SUGAR CANE

Grinding the Cane

ter the cane is stripped and topped, in the "brake," it is
l on cars to the "mill." In the larger establishments the
s lifted from the cars by powerful machinery and "dumped"
nveyors which feed it in between the heavy metal rollers
queeze out the juice. (Fig. 20.) In some mills the cane

of cane in twenty-four hours. Between the first and second set of rolls the cane is often sprayed with hot juice, and between the second and the third set with hot water in order to increase the yield of sugar extracted.

The crushed cane which is called "bagasse," still contains a little sugar that it has not been possible to extract. The bagasse is dried by passing it over the boilers on conveyors, and is then used for fuel in the furnace.

Purification of the Juice

The juice which is quite dark colored and turbid contains considerable organic matter other than sugar. To remove this it is often treated with the fumes of burning sulfur, or with bisulfite of lime, and then heated with lime. This process is known as "defecation." The lime neutralizes any acid that may be in the juice and thus prevents some of the cane sugar from "inverting" or changing into the uncrystallizable invert sugar. The lime also causes a coagulated scum to form and this is skimmed or filtered off. This scum carries away many of the impurities of the juice, especially those of a nitrogenous character. It, however, retains considerable sugar, so that it is pressed by means of a heavy filter-press (see Fig. 64) to recover as much of the juice as possible. The residue or "press-cake" as it is called is sometimes utilized as a fertilizer. The expressed juice is added to the main portion of the juice to be afterwards treated.

Evaporation of the Juice

The clarified juice obtained by the defecation or filtering mentioned above, is evaporated in the so-called "multiple effect" vacuum pans. (Fig. 21.) In the first pan of the multiple effect the air is exhausted to such an extent that exhaust steam from the engines and pumps of the factory will, when entering the steam jacket of the pan, cause the juice to boil and thus concentrate under the partial vacuum, produced by the pump. The steam arising from the boiling juice of the first pan enters the jacket of the second pan, and as the vacuum of this pan is higher, the temperature of the steam from the first supplies sufficient heat for further evaporation. This process continues in the entire battery of from two to five pans; that is the juice and vapor pass from one "effect" to the next, until the sirup is pumped from the last pan, and the final vapor condensed by a cold-water spray. It is evident that by this process a great saving of fuel is effected.

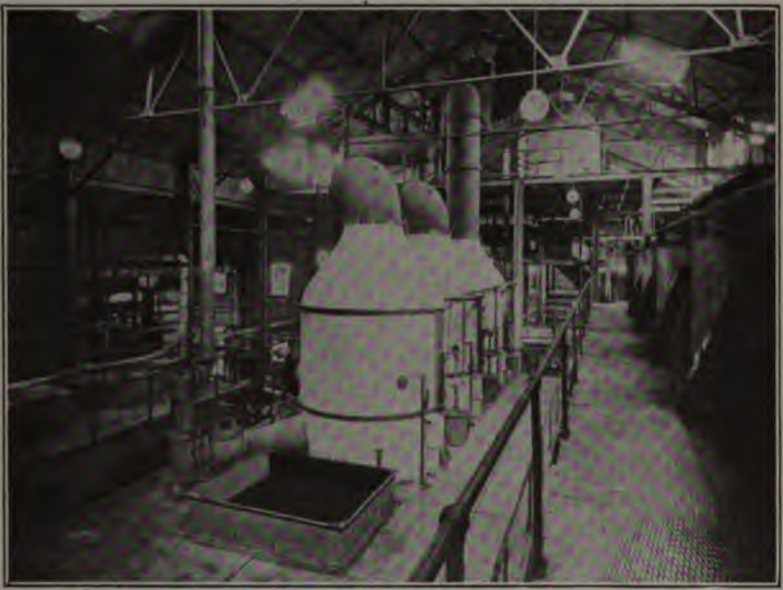

FIG. 21.—Triple effect condenser, for concentrating sugar solutions.

Sugar Boiling

The concentrated juice is next run into the "strike pan," (Fig. 22) which is a large boiler heated by steam coils, and connected with an exhaust pump so that a very high vacuum can be maintained. After the mass has begun to crystallize or "grain" additional sirup is allowed to run in from time to time, until the pan is finally filled with the crystalline sugar, mixed with molasses. In this high vacuum the concentrated sugar solution boils at from 150° F. to 180° F., so there is no danger of its burning.

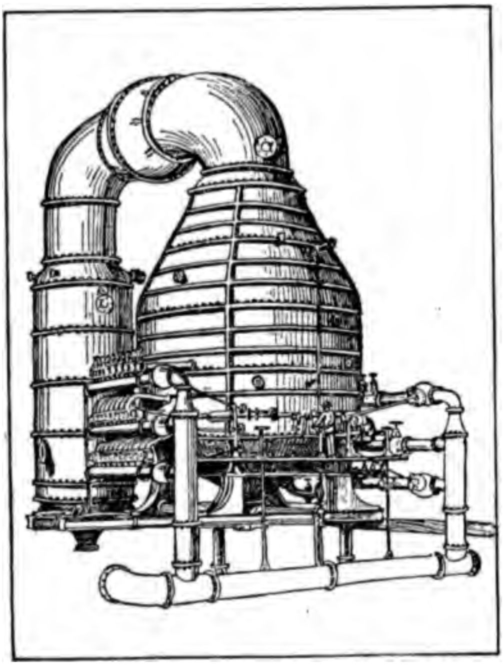

FIG. 22.—Vacuum Strike Pan, Farmers' Bull. No. 82. (By permission U. S. Dept Agric.)

The Centrifugals

The warm mixture of sugar and molasses known as "masse cuite" is next stirred in a mechanical mixer so that it may be of uniform consistency, and is then run into the "centrifugal." (Fig. 23.) This machine was first successfully used for this purpose in 1860. It consists of a drum running on a perpendicular axis at the rate of 1000 to 1200 revolutions per minute. The sides of the drum are composed of perforated metal so that when the mixture of sugar and molasses is rapidly rotated or "swung out" the molasses is separated from the sugar by the centrifugal motion.

gar is washed with a little water just before it is dumped
he centrifugals. The sugar thus produced is dried and
on the market. Sometimes salts of tin are used at this
n the process in clearing the sugar, and ultramarine blue
sionally added to correct the slight yellow color. The use
latter substance is to be deprecated as sugars containing
arine are not suitable for use in some of the arts, as for in-
in making fruit sirups.

Cultivation of the Sugar Beet

In the cultivation of the sugar beet, the sugar content and purity of the juice depend not only on the variety planted, but on the soil, climate, weather and distribution of moisture. If possible the beets should not be harvested until the coming of the frost, as every day added to the growing season increases the sugar content.[1] In a mild climate beets can be stored in the open air until used but where there is danger of frost they must be kept under shelter. The highest amount of sugar is obtained in irrigated regions where there is an abundance of sunshine, and where the distribution of the water can be regulated. (Fig. 24.) The beet matures best where the average temperature of June, July, and August is about 70° F. The average per cent. of raw sugar extracted from the beet in the United States in 1908 was 12.6 per cent.; in Austria 17.2 per cent.; in Germany 17.5 per cent. The first successful sugar beet factory in the United States was built at Alverado, California in 1870, and has been in operation practically all the time since then.

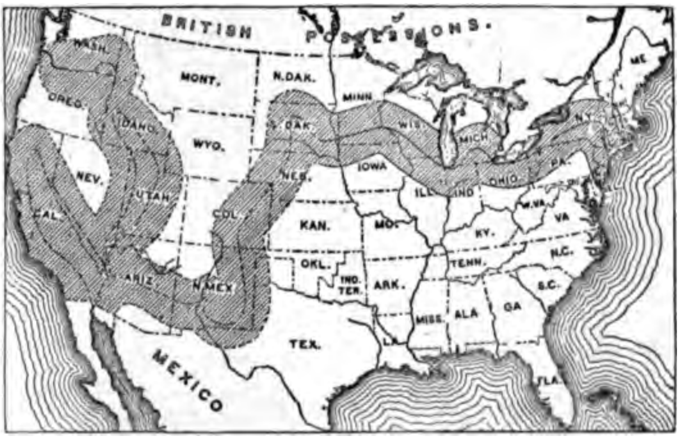

FIG. 24.—Temperature zone in which the sugar beet attains its greatest perfection. (By permission U. S. Dept. Agric.)

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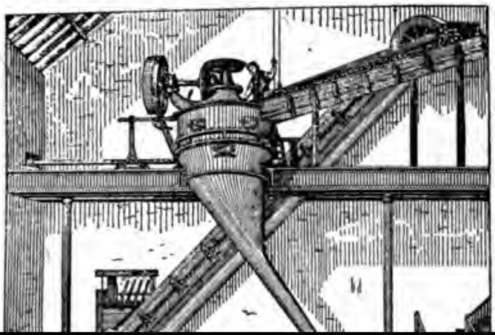
[1] Beet Sugar Manufacture, Claussen.

MANUFACTURE OF SUGAR FROM THE SUGAR BEET

The Diffusion Process

er the beets are brought to the factory they are thoroughly , then passed into a machine in which they are cut by evolving knives into small pieces called "cossettes." The



chips. The saccharine juice increases in density as it passes through the chips. The warming of the juice to 75° to 80° C. in a heater placed between the cells, facilitates this process. The diffusors are connected in such a way that the more concentrated juice comes in contact with the freshly filled cells. Sugar, being a crystalloid is extracted by water through the principle of osmosis, leaving many impurities undissolved. When the chips are exhausted, they are dropped out of the vessel, sometimes pressed to obtain the last of the liquid, and finally sold as cattle food.

Purification of the Juice

In the process of the evaporation of the diffused beet juice, it is heated with lime, which neutralizes the free acid and assists in coagulating the nitrogenous matter. Carbon dioxide gas is passed through the solution, thus precipitating the lime, and with it many of the impurities contained in the juice. After filtering, this process called "carbonatation," is sometimes repeated. The juice is usually treated with sulfur dioxide gas which bleaches it, but care must be taken that the solution still remains slightly alkaline, otherwise inversion of the sucrose may take place.

The purified juice is evaporated as in the case of cane juice (p. 105). The molasses from the beet sugar process cannot be used for making "second" and "third" sugars, as is molasses from cane sugar boiling. On this account the molasses is boiled down and treated in the cold with lime which some have thought precipitates calcium saccharate[1] ($C_{12}H_{22}O_{11} . 3CaO$), which is separated from the solution by filter-presses, and the solid cake thus formed is used in liming juice for carbonatation. This is known as the "Steffen's" process. Each beet sugar factory has its lime kiln, where the lime is burned and the carbon dioxide given off is collected and run into the carbonatation tanks, and the lime is used to precipitate the sugar as saccharate. Sometimes the purified juice is boiled to a fine grain and the strike is transferred to a tor and from thence to the centrifugals, making only refined the process.

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[1] Industrial Chemistry Rogers, p. 892.

SUGAR REFINING

t of the sugar that is imported into the United States and that from Louisiana and Texas is the crude product known " sugar, and contains from 2 to 3 per cent. of impurities. refined in the large refineries of New York, Philadelphia, New Orleans and San Francisco. In one of the largest refineries 13,000 barrels of sugar per day are refined.

crude sugar is "melted" in warm water, filtered and then ted" with lime or with fresh blood from the packing The solution is filtered through long "bag" filters, ng through two or three floors of the refinery. The clear ored liquid is allowed to percolate slowly through bone ters, which also occasionally extend through several stories uilding. The colorless liquid thus obtained is now ready entration in the vacuum pan as described on p. 102. A and a third sugar is frequently made from the molasses into cubes, which were put on the market as "lump" or "cube" sugar. The retail price of this sugar in the United States is often out of all proportion to the extra cost of manufacture; it becomes a "luxury" product. Sugar loaves are still sold by the grocers on the Continent and the purchaser breaks them into lumps of any required size. The granulated sugar is in Europe somewhat more expensive.

Powdered Sugar

From the imperfect pieces or from the original sugar loaf, "pulverized," "powdered" or "icing" sugar is made by simply grinding in a mill and bolting. To prevent this sugar from becoming lumpy it is sometimes prepared for the market by mixing with it a small quantity of starch. Four grades of this sugar, which are of different degrees of fineness are made, but the XXXX is the variety in common use. It is often asserted by housekeepers and food manufacturers that there is a difference in the cooking quality of cane and beet sugar. Experiments[1] show that although beet sugar produces more froth in making sirup, this is wholly due to its fine granulation. There seems to be no difference in the keeping qualities of jelly or canned goods made by the use of either of the two sugars. Chemical analysis shows them to be identical.

MANUFACTURE OF MAPLE SUGAR

It is probable that the North American Indians were the first manufacturers of maple sirup.[2] All species of the maple tree yield a sweet sap but the Acer saccharinum (sugar maple) and the Acer saccharinum nigrum are species best adapted sugar making.

Tapping the Trees

In order to obtain the sap, a hole about 1/2 inch in diameter is bored in the trunk of the tree, to a depth of 2 or 3

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[1] U. S. Dept. Agri. Bur. Chem. Bull. No. 134.

[2] U. S. Dept. Agri. Bur. Forestry Bull. No. 59, and Vt. Agri. Ex. Sta. Bull. No. 103.

Sometimes a "spile" or pipe, made from elder wood
e pith removed, is driven in this hole to carry out the sap,
ore modern process is to drive in a metal spout just below
ning. To this a bucket, which should be covered, is at-
to catch the sap. Much attention[1] has been paid to such
ns as the side of the tree to be tapped, the number of holes
to the size of the tree, the proper time of the year for
, and the best way of collecting and storing the sap. It
ved that the best flow of sap is obtained when the tempera-
such, that it is freezing at night and thawing during the
e.

Boiling the Sap

sap, after being collected from the trees is stored tempo-
wooden or metallic tanks, and then boiled down as rapidly
ible. The evaporating is often done in a crude way by
boiling in iron kettles over an open fire, but this method
n largely superseded by the use of rectangular sheet-iron

"sugar sand" (an impure malate of calcium), and suspended dirt are removed. Any carelessness in the methods of collection of the sap or in evaporating, will result in a dark-colored, strong-flavored sirup, which commands a lower price than that which is made more carefully.

Composition of Maple Sirup

Sirup that is carefully made and stored in sealed cans will keep for several years. A good sirup should weigh not less than 11 pounds to the gallon and should not contain more than 32 per cent. of water. The average amount of sucrose in a good quality of maple sirup is 62.6 per cent.[1] and the invert sugar 1.47 per cent. If the invert sugar is high it indicates that the sap has been allowed to sour, or that the sirup was carelessly made.

Formerly in the United States there were hardly any food products more frequently adulterated than maple sirup and maple sugar, but since the enforcement of the Food and Drugs Act of June 30, 1906, manufacturers are now required to state upon the label the true nature of the product.

Maple sugar and sirup are most extensively made in Ohio, New York, Indiana, New England, Pennsylvania, Michigan and West Virginia. Maple sirup and sugar are also made in Canada, but not in the South, west of the Missouri River, or in Europe. The total amount of maple sugars and sirup as sugars produced in 1919, according to the United States census reports, was 41,506,800 pounds.

Maple Sugar

Maple sugar is readily made by carrying the process of concentration still further or until the mass boils at about 240° F., and then pouring the hot sirup into molds to solidify. This is never refined, as its value depends on certain ingredients other than sugar that give it an agreeable flavor, and these very substances would be removed in the process of refining.[2] The crop about equally divided between sugar and sirup, but the tion of the latter is rapidly increasing. Much dark, inferior sugar is used in making the various mixed sirups which are on the market.

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[1] U. S. Dept. Agri. Bur. Chem. Bull. No. 134, Farmers' Bull. No. 516.

[2] Cyclo. Am. Agri., L. H. Bailey, Vol. 2.

the early history of the American Colonies in addition to maple sugar was the chief sweetening substance, and ry cheap, but with the improved methods of making white rom the cane and beet, the price of white sugar has steadily while maple products, on account of the limited supply, have ed in value. At the present time the demand for maple partly met by the sale of cheap mixtures consisting of cane lavored with maple, or with some flavoring material that at suggests" maple products. If properly labeled, there can objection to the sale of such products, although the price d is often entirely out of proportion to the value of the ents used. Maple sap contains on the average about 2 per f sugar. With sap of the ordinary composition, a barrel of 2 gallons) should produce a gallon of sirup.

absolute alcohol. A lower grade of the same spirit is made from fermented rice.

Raw Sugar

The average composition of "Raw Sugar" from different sources is as follows:

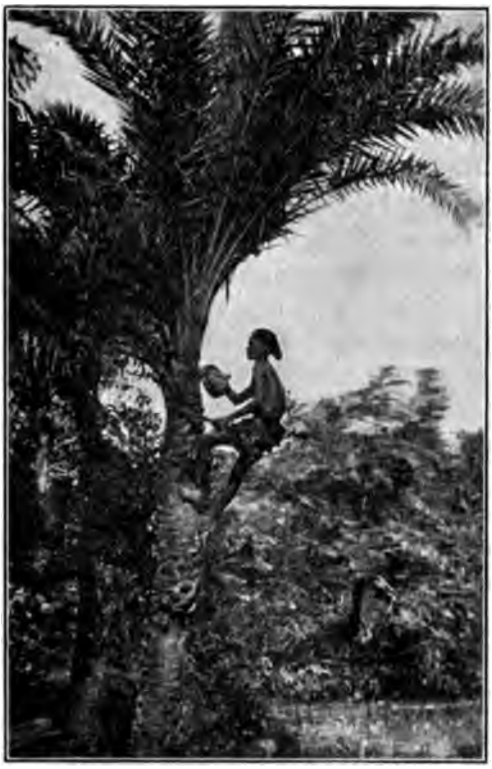

FIG. 26.—Getting "toddy" from a palm tree.

Sugar from	Water	Cane sugar	Other org.	Ash
Sugar cane	2.16	93.33	4.24	1.27
Sugar beet	2.90	92.90	2.59	2.56
Palm	1.86	87.97	9.65	0.5
Maple	7.50	82.80	8.97	0.

SUGAR AS FOOD

e time has long since passed when sugar is to be regarded
ere luxury, although on account of the use of sugar in con-
ery the luxury phase of the subject can never be ignored.
process of plant growth the starch in the later stages is
ted into sugar, and as far as nutritive value is concerned
re very much alike.

rchy[1] food must first be acted upon by a ferment in the
and then by a second ferment contained in the intestines,
it is in a suitable condition to be taken into the blood as
ient. Cane sugar, on the other hand, does not require as
x a treatment before it can be assimilated. Cane sugar is,
h the action of certain enzymes or ferments by the process of
sion," changed in the digestive tract, into glucose and fruc-
simpler sugars—which are then ready for absorption. It is
ting also to note that when more sugar or starch is consumed
actually needed, some of it is changed in the liver to a pecu-
rchy substance called "glycogen" $(C_6H_{10}O_5)_x$, and is there

Sugar is well adapted to help man in the performance of extraordinary muscular exertion. For this purpose it may be given in lemonade, or if a solid is desired mixed with chocolate. Its value has been proven in the German army by experiments with soldiers on the march.

Starch is a satisfactory food where muscular exertion is required, but if a part of this is replaced by sugar, there is less tendency to fatigue. As sugar has the advantage of being more readily digested, it is of special value for those individuals who have not the ability to digest starch. This is particularly true of infants for whom milk sugar is the natural diet.

There are many instances on record of the large consumption of sugar by workmen, and seemingly to their advantage; among these may be mentioned the negroes of the South, lumbermen working in the woods and mountain climbers in the Alps. As a feeding stuff for the lower animals sugar is already of importance in the South where "Black Strap" (the liquor left after the last crystallization of sugar) is a part of the regular diet of mules and sugar is fed to cattle and used for fattening steers.

As to the quantity of sugar that should be allowed in the daily ration, it has been ascertained that in many well-to-do families in the United States as much as 2 pounds per week per capita is used. This would mean in an ordinary family not less than 500 pounds per year. The amount of sugar used per capita in different countries varies with the climate, the habits of the people and very often with their financial ability to obtain it. This amount is however constantly increasing, for with sugar, in normal times, at 6 or even 7 cents per pound, it compares favorably with other foods as a source of energy, although more expensive than wheat flour and corn meal.[1]

As valuable in the dietary as sugar has been proved to be, there is danger in using too much, since an excess cannot be readily digested and will produce acidity of the stomach, and flatulent dyspepsia. This is particularly true in the case of persons living tary life, or having a tendency to corpulency. Children heir active lives, out of doors, and their rapid growth, doubt assimilate more sugar than adults, but on account fondness for it, there is danger of their eating too much and ausing indigestion.

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[1] U. S. Dept. Agri. Farmers' Bull. No. 535.

PRODUCTION OF SUGAR

ording to Willett and Gray the sources of sugar produced in ld in 1919 are as follows:

	Tons	Per Cent.
es.	192,000	1.18
	226,000	1.38
	250,000	1.53
s.	278,555	1.70
co.	362,618	2.22
& Japan	[illegible]	[illegible]

that the greatest sugar-producing country of the world, Cuba, is at our door, so the cost of transportation was comparatively small.

The total amount of sugar produced in Europe in 1910–11, which was of course from beets, was 8,032,741 tons, and the same year Germany exported 1,125,868 tons.

Since the signing of the armistice, the conditions of production have been so abnormal, and the opportunities for taking excess profits so great, that any figures in regard to per capita consumption and cost are of little value.

Consumption per Capita

The sugar consumption per capita (all kinds of sugar included) in 1910–11, and the retail cost per pound to consumers was as follows:

	Consumption per capita	Retail price per pound, 1911
Great Britain	91.63	5 cents
Denmark	84.23	5 cents
United States	79.20	5.69 cents
Switzerland	76.34	5.10 cents
Sweden	57.98	8.00 cents
Germany	47.91	5.90 cents
France	42.84	5.90 cents
Italy	10.10	14.00 cents
Servia	7.90–7.94	8.70 cents

In considering the amount of sugar used in different countries the controlling factor is the cost as represented by the amount of sugar that can be purchased out of the ordinary daily wage. In Germany where labor is cheaper than in the United States, sugar costs about as much, and in Italy, although labor is still more poorly paid sugar costs from 14 to 16 cents a pound. Germany its own sugar while in Italy there is a manufacturer's tax of per 100 pounds, and an import duty of \$8.67 per 100. The production more than equals the comsumption of the coun- ut the cost of manufacturing is so high that it does not pay to t the sugar.[1]

GLUCOSE (Fruit sugar) ($C_6H_{12}O_6$)

he next important group of the carbohydrates is the glucose (p. 17). These substances are closely related to the bers of the starch-cellulose group, for both starch and ose on boiling with dilute acid are converted into grape sugar,

$$\underset{\text{Starch or cellulose.}}{(C_6H_{10}O_5)_n} + H_2O = \underset{\text{Grape sugar.}}{(C_6H_{12}O_6)_n}$$

uit or grape sugar is also closely related to cane sugar, for eviously stated, it may be produced from cane sugar by sion with acids and heat, the products being dextrose ($C_6H_{12}O_6$) evulose ($C_6H_{12}O_6$). In a similar manner milk sugar breaks drolysis," as it is called, of starch by heat and dilute acid. The manufacture of the starch and its conversion into glucose are most economically conducted in the same factory. For this purpose, in the United States the corn (maize) is softened by steeping with warm water, and cracked to loosen the germs. The coarse meal then passes to the separators where the germs are floated off; these may be used as cattle food or for the manufacture of corn oil. The meal is then ground fine, and passed with water over shakers or through slowly revolving perforated cylinders to remove the hulls. The starch remains suspended in the milky liquid. On the Continent of Europe potatoes are utilized for the manufacture of the starch for making glucose.

The next process consists in "inverting" the starch, which is accomplished in large copper boilers by the use of about 6 pounds of hydrochloric acid to 10,000 pounds of starch. After this has been heated for some time under pressure, it will be found, on testing, that no starch remains. The free acid is then neutralized with sodium carbonate, the solution is decolorized by filtering through bone black, and concentrated in vacuum pans, by methods similar to those employed with cane sugar juice. Although it may be possible to "convert" the starch without the use of acid under special conditions, it has been found more practical to use small quantities of acid in the process. This acid is completely neutralized in the final product.

When commercial *glucose* is to be made, the process of converting is arrested while there is considerable uncrystallizable dextrin in the product. The concentration is carried only far enough to produce a heavy thick sirup. This contains about 35 per cent. of dextrose, from 4.6 to 19.3 per cent. of maltose and from 29.8 to 45.3 per cent. of dextrin.

Grape Sugar

For the production of commercial "*grape sugar*," the conversion of the starch is carried farther than for the glucose, and the concentration in the vacuum pan is carried so far that on cooling a

ystalline solid remains. This contains from 72 to 99.4 per
f dextrose, and without doubt some caramelization has taken
in those products which are most concentrated. This gives
tter a brownish color, and the product is often used for
g "glucose" or "grape" sugar vinegar, which is thus colored
itate cider vinegar, and yet contains no "added color."
se is put on the market in various degrees of concentration
as "A," "B," and "C." Formerly in the process of
g glucose and grape sugar sulfuric acid was used to hydrolize
arch, instead of hydrochloric and marble dust was added
luce calcium sulfate, and thus neutralize the free acid. The
n sulphate was removed by settling and filtration.

nong the other products of the glucose factories are "mixing
e," used in making table sirups (see p. 129) "jelly glucose"
onfectioners" glucose.

Glucose as Food

icose products are considered wholesome. In a report caramel, and in confectionery; it is used in making artificial honey and as a substitute for malt in brewing. Glucose has not as great sweetening power as cane sugar. Some authors state that the relation is about as 3 to 5. The author found that 1 pound of cane sugar was equivalent to 1 1/3 pounds of glucose.[1]

In some states the contention was made that the term "corn sirup," was not a proper name to apply to a glucose product. A sirup is made by concentrating a natural juice or sap, but the starch product is entirely artificial. Again, it was said that on account of the prejudice of the public against the term "glucose" the word "corn" was used. It was held that the term corn sirup could be properly applied only to a sirup made by concentrating the juice of the corn stalk, and not to an artificial product which may be made, and indeed often is made from potato starch rather than from corn starch. This matter has been in litigation for some time, but by the ruling of the U. S. Dept. of Agriculture, the term "corn sirup" can be used in describing this glucose product.

The total amount of glucose and of grape sugar made annually in the United States is 1,000,000,000 pounds, and in this industry no less than 50,000,000 bushels of corn are used. This is nearly all made in a few factories which control the output. The use of glucose sirup is rapidly increasing, especially since cane sugar has been so scarce.

MANNA

Manna is a saccharine substance exuding from various trees. The substance usually called manna, however, is from the juice of the *fraxinus ornus*, a species of ash which is grown in Sicily and other parts of southern Europe. The juice which exudes from slits made in the stem of the young tree, when it is dried, is known as "flake" manna. It has a sweetish taste and characteristic odor and contains a crystallizable sugar called "mannite" ($C_6H_8(OH)_6$), and several uncrystallizable sugars. It is used in medicine as a laxative.

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[1] First Quar. Rep. 1885, K. St. Bd. Ag.

URCES AND METHODS OF MANUFACTURE OF MOLASSES AND SIRUPS

is well to distinguish carefully between *molasses* and *sirup*. rly speaking molasses or treacle as it is called in England, liquor which remains when a saccharine juice has been ntrated to the point of crystallization, and some of the has been crystallized out. The "mother liquor," as the st would call it, from which the sugar has crystallized is the ses. It contains besides sucrose, some of the uncrystalliz- sugar of the original juice, and all the "invert" sugar ced in the process of manufacture; besides this all soluble ities and the mineral salts of the original juice here present omewhat concentrated condition.

up, on the other hand, is the product obtained by the simple ration of the original juice, from which no sugar has been ed. So we may have "sugar-cane" sirup, "sorghum" and "maple" sirup.

to make a second sugar, and often the drippings from this are boiled to make a third masse cuite—the third molasses necessarily contains all the impurities of a considerable amount of juice. There are present also, besides uncrystallizable sugar, mineral salts and organic matter. The last molasses on the plantation, is called "black strap" and is fermented to make alcohol, or used in the manufacture of mule feed by mixing it with ground grains and alfalfa, in such proportions as to form a "balanced" ration. On account of the large amount of impurities contained it is not fit for human food.

Sugar Cane Sirup

An "open pan sirup,"[1] or "sugar cane sirup" which is very satisfactory, and should take the place of the molasses described in the previous paragraph is now made in many of the Southern States, especially Georgia, Alabama, Florida, Louisiana and Texas. This sirup is made by simply clarifying and evaporating the sugar cane juice to a consistency where 25 or 30 per cent. of water remains, and a product is obtained that keeps reasonably well. During the process the scum is carefully removed, and the final sirup is strained. No lime or sulfur is used in the process and, in fact, these chemicals are not necessary. Sulfur fumes are often used in products of this kind to bleach the material, but there is really no reason why a lighter colored product should be preferred, and the sulfuring certainly injures the flavor.

Many southern manufacturers still contend that the use of sulfur and lime are essential to produce a product that keeps well and does not crystallize.[2]

Sugar House Molasses (Refined Molasses)

In the process of sugar refining, which has already been referred to, a molasses remains after the crystallization of the third sugar, which is extensively used in making commercial sirups,

[1] U. S. Dept. of Agri., Bur. of Chem. Bull. No. 70, 103.

[2] La. Bull. No. 129.

flavor, or to disguise the glucose taste. This molasses is of
ch lighter color than the product from the sugar factory
k strap), but contains a very large amount of soluble organic
ances not sugar, and considerable mineral impurity. It is
suitable food, unless used in the small quantities previously
l.

Sorghum Sirup

ne of the common sirups in use is that made from the sorghum
hum saccharatum) or Chinese cane. It appears that the
um plant originally grew wild throughout tropical and sub-
al regions of the Old World.[1] Although very extensive
iments have been made under the direction of the U. S.
of Agriculture,[2] especially in Kansas, in the "eighties" it has
een found practical to use this juice for the manufacture of
. In some of the states of the Middle West, Kentucky,
essee, Missouri, Kansas and Texas, sorghum is grown ex-
ely for the manufacture of sirup for local use. During and
after the Civil War this industry was also carried on through

about 36 per cent. of sucrose, and 27 per cent. of reducing sugar. The yield of sorghum is 50 to 100 gallons of sirup per acre.

Commercial Sirups

Many of the "*table*" sirups on the market are mixtures of various saccharine products, and have glucose (p. 118) as their base. This, as has been stated, is a colorless product, wholesome enough, but not so sweet as cane sugar. In making these mixed sirups, the commercial glucose is warmed[1] and into it is stirred some maple sirup, brown sugar, refiners' molasses, cane sugar molasses, or sorghum, as the case may be. In many states the manufacturer is required to state upon the label the per cent. of each ingredient used. The trade name used for the sirup must not be misleading at least in regard to the source of the product. The labels used on many of the commercial sirups are open to the objection that they conyey a false impression as to the quality of the product. Sirups labled "maple and cane" or "cane and maple," usually contain only small quantities of maple. In mixtures of this kind the most abundant ingredient should always be placed first, and the size of type used should not be such as to be misleading as to which ingredient is most abundant.

The chief excuse for using these mixed sirups is that they are cheap. They are liable, however, to contain an excess of mineral impurities or bleaching substance which make them unwholesome. At any rate they can never compete either in delicacy of flavor, or in wholesomeness, with such products as pure maple sirup, or open pan cane sirup. An excellent and agreeable pure sirup may be made for home consumption by dissolving, by the aid of heat, two cups of granulated sugar in one cup of water. A small quantity of cream of tartar will prevent crystallization.

Adulteration of Sugar and Sirup

The adulterations to which molasses and sirup are liable have been already discussed. Sugar is usually sold at such a low price

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[1] Foods and Their Adulteration, Wiley, p. 479.

ı the United States, at least, it is seldom adulterated. Ultra-
e when added to granulated sugar (p. 112) is considered an
rant, as are also the salts of tin, which are indeed poison-
It may be permissible to add a little starch (not over 1 per
to powdered sugar, so that it shall retain its pulverulent
nd not become lumpy, but the addition of any mineral sub-
such as chalk, or magnesia for this purpose should not be
tted. No appreciable quantity of sulfites should remain in
gar sirups or molasses, as these are injurious to health.[1]

Saccharin

ccharin (benzoyl-sulphimide) $C_6H_4.CO.SO_2.NH$ is a white
lline coal tar product, soluble in 400 times its bulk of cold
When pure it is 550 times as sweet as cane sugar. Sac-
e was discovered by Dr. Remsen and Dr. Fahlberg of
Hopkins University. In the United States, its use is not
d in foods or beverages, and its manufacture was at one

The characteristic flavor of old rum is due to the presence of ethyl butyrate, ethyl acetate and furfurol, which are developed in the process of "aging," by storing for some time in oaken casks. In genuine rum the per cent. of absolute alcohol is usually from 43 to 50, although much underproof liquor is sold.

CONFECTIONERY

There is a continually increasing demand for confectionery. In the United States it is called "candy," and in England it is known under the various names of "sweets," "toffey," and "barley sugar."

The materials used in confectionery are so various that there is difficulty in classifying them, and the food chemist finds that no satisfactory standards have yet been made for these products. The basis of all confectionery, however, is cane sugar or glucose, and to this is added gum-arabic, flavors, extracts, colors, milk products, fruits, flowers, nuts, gums and special material such as caramel and chocolate. Starch is used in molding confectionery, and is also present in small quantities in the manufactured product. The presence in candy of any mineral substance, injurious color or flavor, liquor or drug is forbidden.

When in normal times granulated sugar costs $5.00 glucose can be bought for about $2.10 per hundred weight. Considerable gum-arabic and gelatin is also used, especially in making gum drops. For making the best quality of cream candy and bonbons cane sugar only can be used.

Soft Candy

To make a soft candy about 25 pounds of sugar is heated with 1 gallon of water and a tablespoonful of cream of tartar, or a few drops of pure acetic acid or even lemon juice added to prevent crystallization. This mass is heated rapidly, usually in a copper kettle directly over the fire until the boiling temperature reaches

F., when it is poured on a marble slab, and partially cooled. hen worked with suitable tools until it creams, an operation similar in its results to the "pulling" of candy. The product wn as "fondant" and is used as the *basis* for the manufacture am chocolates, and similar confections. It may be warmed un into molds of various shapes which have been made in a f starch. For cream chocolates, these lumps of molded fon- re dipped when cold, either by hand or machinery, in a warm late bath.

Hard Candy

or making stick candy a mixture of 9 pounds of cane sugar pounds of glucose may be taken and heated rapidly, with rts of water, to 310° F. to 330° F., then poured on the slab th soft candy, and the flavor, usually an essential oil, added. rking the batch on the slab, the edges are continually turned ward the center. After it has been worked for some time omes somewhat hard and is thrown over a hook placed on the wall, and "pulled" until it becomes white. This mass is and chloride of ammonium, raise the temperature to 150° C. and maintain that temperature for some time. Caramel is slightly bitter but gives an agreeable flavor to confectionery. It is extensively used to give a brownish color to food products and beverages. When the object is to make the product "appear better than it really is" this use is that of an adulterant.

Rock candy is made by dissolving cane sugar in a limited amount of water, and heating to 230° F. In this solution strings are suspended and, as the solution cools, the sugar crystallizes upon them. In order to obtain good crystals the sugar solution must stand for several days in a warm room, where the cooling can take place slowly and the quantity of sugar solution handled must be large. If flowers or fruits are suspended in the sugar solution the product is known as "crystallized" flowers or fruit.

Chewing Gum

The making of chewing gum has become such an important industry that no less than $9,000,000 is invested in the business in North America and England. Originally the gum used was that of the spruce, cherry, etc., but the demand became so great that a gum known as "chicle" is now used as the basis of practically all the chewing gum of commerce. This gum is made from the milky sap of the *sapodilla* which is a native of tropical America. The tree bears a small fruit which has a firm, sweet pulp with a taste something like maple sirup. The gum is produced especially in Mexico, Central America and Yucatan. Incisions are skilfully made in the bark, of the tree and the juice obtained is boiled to a proper consistency and molded into bricks for export. If of first quality, it is firm, nearly white, aromatic and nearly tasteless. Chewing gum, if prepared with care, is nearly white, and free from dirt and other foreign material.

Adulteration of Confectionery

The addition of flavoring and coloring substances to candy is not of course considered an adulteration, but care must be exer-

that they are not of an injurious character. Vegetable
and a few of animal origin are admitted to be satisfactory,
ineral colors are universally condemned. There is a large
f so-called coal tar or anilin colors that have come into com-
ise for coloring confectionery, as they are made in great
y and are extremely brilliant.

ght or more of these, after careful examination by the De-
ent of Agriculture at Washington,[1] have been approved and
own as "certified dyes." Besides these there are no doubt
which are harmless, but as almost every possible color can
duced by the proper blending of these, it seemed best to
imit for the present the number of permitted dyes in food
cts.

the use of glucose bleached by sulfites lies another danger.
igh in most cases the amount of sulfite introduced into candy
s way is small, there is always the danger that a large
t of "bleach" was used on a discolored batch of glucose with
sult that the candy-maker unwittingly gets into his finished

HONEY

Honey is defined by the Association of Official Agricultural Chemists, and by most food chemists as the nectar and saccharine exudations of plants, gathered, modified and stored in the comb by honeybees (Apis mellifica and Apis dosata). The sap of certain trees sometimes gathered by bees, or the product obtained by feeding the bees sugar sirup or glucose, cannot be regarded as true honey. (See Farmers' Bulletin, No. 653, 1915.)

History

From the very earliest history of our race, we read of the use of "wild honey" which was stored as food by the bees in the crevices of the rocks, and in hollow trees. On account of its sweetness and delicate flavor, it was regarded as a luxury and at the same time a delicious addition to the daily food. The honeybee is also one of the most beneficial of insects on account of cross-pollinating the flowers of various economic plants. There are quite a number of instances on record in which numbers of people have been poisoned by eating honey which the bees had gathered from poisonous flowers. Sometimes this honey causes headache, nausea, and a kind of intoxication, but the results of the illness are seldom fatal.

As sufficient honey could not be obtained from the stores of the wild bees, man soon learned to raise the swarms in hives, under his own control. The hives[1] are so constructed as to afford the bees protection against inclement weather and to allow the removal from time to time of "frames" or boxes which the bees have filled with honey. The invention of the movable frame hive in 1851, by L. L. Langstroth of Philadelphia, marked a great advance in this industry.[2] These hives hold from eight to ten frames, and one of their best features is making the spaces between frames, side walls and "supers" accurate so there is just room for the passage of the bees. A comb foundation stamped from wax which the bees start to build their combs is often placed in box.

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[1] U. S. Dept. of Agri. Farmers' Bull. No. 59.

[2] Cyclopedia of American Agriculture.

Comb Honey vs. Extracted Honey

oney is frequently put on the market as comb honey, and in orm is not liable to adulteration, but there is also a demand trained honey. The comb honey commands a better price and usually retains to the greatest extent its delicate flavor. Extracted honey or strained honey is more suitable for shipping long distances. The honey is usually extracted by carefully cutting with a knife the top of the honey cells and then spinning the honey out with a centrifugal machine. (Fig. 27.) The comb by this method is left in a condition to be returned

is about 17 per cent. and the ash 0.18 per cent. Whenever the dextrose is in excess of the levulose the presence of adulterants is to be suspected.

Honey as Food

On account of the inverted condition in which most of the sugar occurs, honey is generally regarded as a very wholesome food. It is actually richer in sugar than the "malt extracts" recommended for invalids; and as the sugar is in a form that may be readily assimilated if taken in moderate quantities, it forms a valuable addition to the diet.

Adulteration

The most common adulterants of honey are cane-sugar sirup, glucose and a product made by the inversion of cane sugar by acids. The presence of these can, however, be detected by the chemist, and since the enforcement of National and State food inspection laws, adulterated strained honey, which was formerly one of the most common products on the market, has been almost completely eliminated. A method of falsification formerly practised was to place some honey comb and a few dead bees in the can of so-called honey in order to convey the idea that the product was genuine. If the honey is purchased in the comb as capped with wax by the bees, there is little danger that it is not genuine. It is true that bees may have been fed on glucose or cane sugar, but as they do not thrive on this diet, the practice is not very common. Crystallization is more likely to occur in pure than in impure honey. The crystals may be dissolved by heating in a double boiler. Honey keeps best if stored in a warm, dry place.

Favorable Localities

In the United States, honey can be produced almost anywhere, but in northern regions the winters are sometimes so severe that the bees do not survive, and in some sections flowers yielding r are not abundant enough. The locality has therefore conble influence on the quality of the product. An interesting ation of this is in the fact that the Hawaiian honey shows a amount of common salt in the ash than do other honeys, n the lower grades there is so much "honey dew," which is red by the bees from the exudations produced by various insects and plant lice, that this honey has sometimes been cted as not being genuine.

Quality

he quality of honey is much influenced by the character of owers visited by the bees; so we have "buckwheat" honey is dark and has a strong flavor, and "white clover honey" has the reputation for possessing a most delicate taste. honey made from the flowers of the alfalfa, mellilotus, golden thyme, sage, orange, apple tree, gum tree and basswood has ch case a characteristic flavor. In Abyssinia a peculiar wine de by the fermentation of honey. *Mead* and *metheglin* are

CHAPTER V

ALCOHOLIC BEVERAGES[1]

Alcoholic beverages may be divided into two classes:

(A) Fermented beverages and
(B) Distilled beverages.

The fermented beverages are sub-divided into two classes:

1. Those fermented without the addition of yeast.
2. Those fermented with the addition of yeast (Malt Liquors).

A. FERMENTED BEVERAGES

1. Those beverages fermented without the addition of yeast are wine, cider, perry and similar beverages made by the natural fermentation of saccharine fruit juices, and a few beverages made by the natural fermentation of starchy solutions.

Malt Liquors

2. Those beverages fermented with the addition of yeast include ale, beer, lager beer, porter and stout.

History

The manufacture of fermented liquors from grains is of very ancient origin, at least 2,000 years old. The process was known to the ancient Egyptians, Romans, Spaniards, and Germans, and was introduced by the latter into Great Britain and later

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[1] Beverages, both non-intoxicating and intoxicating, are classified under the general head of foods, and are therefore here discussed.

he United States. The knowledge of alcohol as a constituent
e or beer was not known until the time of Marcus Graccus,
rote in the twelfth or thirteenth century of the distillation
these beverages,[1] of a substance called "aqua ardens."
formation on a process for making beer seems to be nearly
l as that for making wine; but the Greeks and Romans re-
d beer as a barbarian drink. Beverages brewed from such
s as rice, millet, rye and barley are common in Africa,
a, Japan and China.

Chemistry of Beer Manufacture

alt liquors, although primarily made from malt, or "sprouted
," may be made from the infusion of wheat, rye, oats, rice,
(maize), with the addition of other substances such as beet
potatoes, sugar, molasses, glucose, etc., in fact all that is
sary is to have a starchy or saccharine substance capable of
ntation with yeast.

unorganized ferments like zymase, and insoluble organized ferments, which are minute vegetable growths. Chemical reagents bring about reactions which are analogous to the changes brought about by the unorganized ferments, as for instance, boiling with dilute acid perfectly imitates the hydrolytic action of diastase on starch.[1] (See also p. 15.)

Lavoisier was the first chemist to study fermentation from a quantitative standpoint. Gay-Lussac first proposed in 1815 the reaction with which we are familiar, representing the chemical change which takes place during alcoholic fermentation:

$$\underset{\text{Sugar}}{C_6H_{12}O_6} = \underset{\text{Carbon dioxide}}{2CO_2} + \underset{\text{Alcohol}}{2C_2H_5OH}$$

The most important of the soluble unorganized ferments, as noted above, is "diastase." This is formed from the abluminoids of such cereals as barley, especially during the process of germination. Its action on the barley is to change the starch of the grain to dextrin, maltose and dextrose.[1] Thus:

$$C_6H_{10}O_5 + H_2O = C_6H_{12}O_6$$

Invertase is another soluble unorganized ferment and is capable of converting cane sugar or sucrose into invert sugar, thus:

$$C_{12}H_{22}O_{11} + H_2O = 2C_6H_{12}O_6$$

This enzyme is contained in yeast and can be readily extracted from it, by filtration and precipitation with alcohol.

The organized ferments or vegetable growths are divided into molds, yeasts, and bacteria.[2] The most important fermentation industries are dependent mainly on the action of yeasts and bacteria. On the phenomena of *alcoholic fermentation* are based the baking, malt liquor, wine, and spirit industries. On *acetic fermentation* depends the vinegar industry (see p. 235) and the

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[1] Industrial Org. Chem. Sadtler, p 203.

[2] Sadtler, loc. cit.

: and other milk industries depend on *lactic* and *butyric* ntations. (See. p. 414.)

Beer Manufacture

ıe starting point in the making of beer is to prepare the *malt.* his purpose barley is steeped in water at 60° F. for two or days, then taken out of the tub and piled on the floor of the ouse to "couch" or heat. As the germination of the grain eds the layers are spread thinner and thinner, and at the f about ten days the tiny rootlets have started, and the germ rown to be about two-thirds the length of the grain. The ct is then dried in a kiln at a gradually increasing tempera- sometimes as high as 180° F. Drying stops the fermenta- and the product, after being sifted, to free it from rootlets erms, is put on the market as malt. In the malting process arch of the grain, by the action of the ferment "diastase," een changed to soluble maltose, dextrin, etc.

alt is used for making beer, malt extract, sirups and sugars,

Constitutional Prohibition

The Eighteenth Amendment to the Constitution of the United States reads: "The manufacture, sale or transportation of intoxicating liquors within, the importation thereof, into or the exportation thereof from the United States and all territory subject to the jurisdiction thereof for beverage purposes, is hereby prohibited." The Volstead Act limits the amount of alcohol that may be present in beverages, to one half of one per cent. Physicians are allowed to prescribe limited amounts of alcoholic beverages, and they may be sold under certain stringent regulations for medicinal use. Alcohol may be withdrawn from the Government warehouses for use in the Arts.

There are upon the market an endless variety of so called "near-beers," which are free from alcohol, and have somewhat the taste of beer. These are carbonated, and frequently contain an extract of soap-bark, so that they foam readily when served.

Action of Beer on the System

Aside from the direct action of the alcohol on the system (see p. 150) the hop extract in beer causes it to induce drowsiness, and it also acts as a tonic in some cases. It causes biliousness in persons of weak digestion, and has a tendency to act as a fat producer, so that if used in excess it produces obesity and greatly distends the stomach.

On account of the extractives present, beer contains more nourishment than other alcoholic beverages. It does not follow from this however that the beer is to be recommended as an economical food.

B. DISTILLED BEVERAGES

(Grain Alcohol)

The common distilled liquors are whiskey, rum, gin and brandy. (See p. 130, 145, 265.) Besides these there are numerous

products obtained in different countries by fermentation
ubsequent distillation of dilute saccharine liquids, or by the
ation of fermented starchy materials.

Materials Used

ne raw materials used in the manufacture of alcohol and
ed liquors are of three classes: (1) weak alcoholic solutions
ne and cider, which by distillation yield a more concentrated
olic beverage, which frequently has, especially on standing for
time, an improved flavor; (2) sugar-bearing material, such
olasses, raw sugar, sugar factory by-products, sugar beets
beet molasses and the sweet juice of various fruits; (3)
ny materials such as corn, rye, rice, barley and potatoes.

Manufacture of Alcohol

make alcohol for industrial and medicinal uses, the raw and per cent. by volume of absolute alcohol and having a specific gravity of 0.834; or by the U. S. Pharmacopœia alcohol is defined as a spirit containing 94.9 per cent. of absolute alcohol by volume and having a specific gravity of 0.816 at 60° F. "100° Proof" or simply "Proof spirit," as the term is used in the United States by the Internal Revenue Service, must contain 50 per cent. by volume of absolute alcohol, having a specific gravity of 0.7939 at 60° F. This proof spirit has a specific gravity of 0.9335 at 60° F. Liquors having a greater alcoholic strength are "above proof" and those less, "below proof." On this basis absolute alcohol is 200 degrees proof, and under the present revenue law one gallon of absolute alcohol pays the same tax as two gallons of proof spirit.

Whiskey, if genuine, is made from the fermentation and distillations of the wort of corn (maize) rye, and barley. Scotch and Irish whiskeys are made from malted barley—mixed with other grains. The flavor of Scotch whiskey is due to the use of malt dried over a peat fire. Kentucky Bourbon whiskey is made by the use of partially malted corn and rye, while the Monongahela whiskey of western Pennsylvania is made by the use of rye with 10 per cent. malt. Irish "poteen" whiskey has a similar flavor to the latter, obtained by the addition of one or two drops of creosote per gallon of the liquor. *Gin* is made by distilling grain spirits with juniper berries.

Liqueurs and *Cordials* are very popular abroad. They are simply alcohol, sweetened, and flavored with herbs, essences and extracts, and often brilliantly colored. Some of the best known are; "Absinth," which was introduced into the French army during the Algerian war, 1844–7, and on the return of the army became very popular in France. It is prepared from spirit flavored with wormwood, angelica root, calamus and other aromatics, and is colored green. The effects of absinth drinking are believed to be much worse, than those produced by excessive use of other alcoholic beverages, on account of the nervous symptoms induced. "Benedictine," which was made as early as 1510 by the Benedictine monks, is strong alcohol flavored with various

ial oils and herbs; "Chartreuse" is made at a Carthusian
near Florence. The spirit is distilled with angelica, hys-
utmeg, peppermint, etc.; "Curaçoa" is made chiefly in
nd by distilling spirit with the dried peel of the Curaçao
h West Indies) bitter oranges; genuine "Maraschino" is
from the small, sour cherries grown in Dalmatia. These
rushed with the pits, mixed with honey, fermented and
ed; "Vermouth," is made in France and Italy from white
which is "fortified" and flavored with various extracts, and
ed for sometime in casks to the direct rays of the sun.

goatskin receptacles (Fig. 28) to the fermentation room. Here the sugar of the juice ferments and the pulque, answering to our cider, results. It is related that not less than 150,000 gallons of this beverage are sold daily in the city of Mexico alone. Another beverage, called Mescal or Tequila, is made by the distillation of the fermented juice.

Chica is the name of a beverage made by the Indians of Peru, and other South American countries, from the fermentation of corn (maize). A bunch of wheat or barley or a wreath of flowers tied to a pole in front of a hut indicates that this beverage is for sale within. They also make a very strong white rum called "*aguardiente*" by the distillation of fermented cane juice.[1]

Physiological Action of Alcohol

Since from the very earliest times alcoholic beverages have been used to excess, the physiological, medicinal and nutritive effects of alcohol have been very widely studied. The use of alcohol as a stimulant, as in medicine, it is not our province to discuss. For the reason that it is assumed to have nutritive qualities, its value in foods, or as a substitute for them, is of importance. Some beverages, such as wine and beer, have a slight food value due to the sugar, or malted starch product, which they contain, but the distilled liquors have no such value.

In some of the work carried on in the respiration calorimeter with a view of ascertaining whether alcohol acts as a food[2] a certain quantity of alcohol was given as a substitute for a calorimetrically equivalent quantity of sugar and starch. It was shown that the quantity of heat produced was identical, whether the subject used alcohol or its equivalent in sugar or starch.

The influence of alcohol on work was also studied by converting the work performed into heat, and the amount of heat was the same, whether alcohol was substituted or not. Other experis showed that the body tissues were slightly more used up alcohol than with sugar.[1]

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[1] Nat. Geog. Mag., Vol. 24, p. 568.

[2] U. S. Dept. Agric. Ex. Sta. Bull. No. 69.

lthough alcohol can, in some respects, be called a food, yet it a food of any practical importance, for it can merely replace ain amount of fat, and perhaps of carbohydrates in the body, its secondary effect on the nervous and vascular systems eracts almost wholly the benefits derived from the produc- of heat and energy by its oxidation.

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utchinson, Food and Dietetics.

CHAPTER VI

ROOTS, TUBERS AND VEGETABLES

Next in importance to the cereals as a source of carbohydrates in our food, stand the vegetables. This term is often used to cover the large class of foods not cereals, that contain considerable starch and occasionally a little sugar. Here are included those very important plants which store starch for the nourishment of the growing shoot in their roots, tubers or underground stems; also those having young stalks that are used as food, and finally the leaves which, served either raw, or cooked add variety to the menu.

Wherever on the surface of the globe edible roots, tubers and cereals can be cultivated, there man has settled and improved the land. More arid or frigid sections are frequented by wild animals, and man is still obliged to live by fishing and hunting. Both North and South America afforded a good climate for the growth of the potato, the yam and the cassava, and the ease with which these starchy foods could be cultivated, exerted no doubt a considerable influence on the rapid settlement of these lands by European immigrants.

Composition

Vegetables in a fresh state contain from 70 to 95 per cent. of water, so there is not a very large margin for nutrients. Dehydrated vegetables have been recently introduced into the market, as they have the advantage over fresh vegetables in keeping qualities, a reduction of 90 per cent. in weight, and 50 per cent. in bulk. Over 40,000 tons were shipped to the troops overseas in 1917–19. The loss in palatability and antiscorbutic power in dried vegetables, can largely be overcome by improved methods of

early in the sixteenth century, and to Florida and Virginia
he Spanish explorers, then to Great Britain from Virginia
t 1565. The wild plant is still found in South America, but
a less developed tuber. It was cultivated in Europe, and
63 recommended by the Royal Society of London, on account
great yield, for introduction into Ireland as a safeguard
st famine. This, however, proved to be a false hope, as
too much reliance was placed in the potato by the Irish,
when a potato disease made the crop a failure in 1846 great
ing resulted.

or many years the potato was extensively cultivated in Vir-
, but was only introduced into New England when carried
from Ireland in the eighteenth century. As late as 1771
s regarded in England as valuable only as food for stock.

Structure

he potato is really a modified stem, which is thickened to
as a receptacle for the starch needed for the propagation

Cultivation

Potatoes are propagated from the eyes of the tubers, as the seeds cannot be depended on to produce the same variety as the parent plant. They can be planted quite early, but the sprouts should not be much above the ground while there is danger from frost. They grow best in a loose, somewhat sandy soil and do not thrive in a hard, clayey soil.

Storage

Although well adapted for storage and transportation, it is important to remember that potatoes will not keep well in a warm place, or where there is much light. They are best stored in a cave cellar where the temperature does not go below 35° F., or in piles, or pits out of doors, covered with straw, earth and manure. The loss in weight by storage during the winter is about 11 per cent., and is mostly due to the evaporation of water. The enzymes of the cells will during this time induce marked changes, as the sugar is broken down and carbon dioxide and water are given off. Some of the insoluble starch is also changed to dextrin and other substances, so the flavor is decidedly different as spring approaches. Potatoes that have been exposed to the light and have turned green, and also sprouted potatoes, contain more of the characteristic active principle "Solanin" ($C_{42}H_{75}NO_{12}$) than do normal potatoes, and have sometimes produced symptoms of poisoning. Some object to the use of the water in which potatoes have been boiled for making bread or soup on the ground that it is poisonous from its solanin content, while others assert that this substance is eliminated by cooking.[1]

Composition

In the edible portion of the potato there is 78.3 per cent. water, 2.2 per cent. protein or nitrogenous matter, 0.1 per cent. fat old water which is then brought to a boil 15.8 per cent. of the n is lost.

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[1] Food and Dietics, Hutchinson, p. 229.

he above tests were made with peeled potatoes, but when with their "jackets" on, the loss was only 1 per cent. of the n, and a little over 3 per cent. of ash, by either process of ng. Nutritive material is therefore saved if potatoes are in their jackets. As soon as the potato is cooked it should ken from the water to prevent it becoming "water soaked," lled to pieces. It should be noted that the temperature of terior of the potato in the boiling process, is several degrees 212° F.

baking potatoes very little nutriment is lost. The starch is ughly cooked as the temperature attained in baking is several es above the boiling point. Unless they are to be eaten diately it is advisable to break the potatoes open as soon as to allow the steam to escape, so that the tuber may not be- "soggy" on standing, then keep in a warm place covered a towel or napkin to absorb the steam. If put into a covered for camping parties, or at sea, or whenever it is impractical to transport fresh potatoes. The process of bleaching by the use of chemicals as applied to this class of goods, is to be regarded in the light of an aduleration, and should not be encouraged. Canned potatoes may also be found convenient under certain circumstances. Potato flour has been much used in Germany.

In the mountains of Peru, where potatoes were grown long before they were introduced among civilized people, the Indians prepare a product called "*chuñu*" by allowing potatoes to freeze in piles on the ground, and treading out the juice with the feet the next morning and afterwards drying. Prepared in this way the potatoes keep well but lose much of their flavor. The chuñu is usually ground in a stone mortar and used in the form of powder to thicken soup.[1]

Potatoes as Food

Potatoes are by no means a perfect diet, in fact they are not as satisfactory as bread if one would live on a single food. As ordinarily used, with meat, milk, eggs—and other foods containing fat and an abundance of protein, they are extremely valuable. They came into general use, after they were introduced, on account of their agreeable taste, abundant yield, superior keeping qualities and ease of propagation. They are valuable because they neutralize the acids of the blood and thus prevent diseases such as scurvy, to which those are liable who are obliged to subsist mainly on salted meats. Potatoes therefore rank next to breadstuffs in Europe and America, as a source of carbohydrates, and as one of the cheapest antiscorbutics.

The Yield of Potatoes

Potatoes grow well in England, Ireland, Scotland, and the north of Europe; in fact they are successfully grown up to 60° north latitude in Sweden. In the United States they are grown

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[1] Nat. Geog. Mag., Vol. 24, p. 568.

abundantly in New England, New York, Pennsylvania,
Michigan and Wisconsin. They are raised as an irrigated
n Colorado and California. In the South they are raised
as an early crop for the spring market. They are also an
ant crop in Canada.

e potato crop of Europe is of more importance than that of
Inited States.[1] In 1910 Germany raised 1,597,000,000
s, France 313,000,000 bushels, Austria-Hungary 690,000,000
s, Great Britain and Ireland 236,000,000 bushels, and the
us year Russia (European) raised 1,173,000,000 bushels.
19; 357,901,000 bushels of potatoes were raised in the
l States.

all and inferior potatoes are used for the manufacture of
l, especially in France and Germany. More care is required
vent the alcohol from potatoes being contaminated with
oil than if the alcohol is made from grains.

r the manufacture of starch from potatoes see under
ch" p. 61.

planting.[1] The roots, which contain the starch grow in clusters often 2 inches in diameter and 4 feet long, with a weight of from 10 to 30 pounds.

Cassava has been most extensively grown in India, South and Central America, Africa, and the West Indies. In the United States cassava may be successfully grown in the southern part of South Carolina, Georgia, Alabama, Mississippi, Louisiana and Texas and in all of Florida. The area is thus limited by the frosts of more northern latitudes, as at least eight months free from frost is needed for the growth of a successful crop.

The sweet cassava does not contain sufficient prussic acid (HCN) to be dangerous, while the bitter cassava contains enough of this poisonous substance to make it unsafe to use without special preparation. The sweet variety has been found to contain not more than 0.01 per cent. of hydrocyanic acid (HCN), while the bitter varieties contain from 0.02 to 0.77 per cent. The cassava is of American origin, and has been used for centuries as food by the South American Indians, who peel and cook all varieties.[2] They make a thin cake from the meal. This is the cassava bread —a staple food with all classes. The juice extracted from the pulp of the bitter cassava yields a substance known as cassareep,[3] which is used in making up the flavor of Worcestershire and other sauces. (See p. 440.) This juice is concentrated by boiling and the prussic acid is in this way eliminated.

There seems to be no fixed standard by which the sweet varieties can be distinguished from the bitter, and it is in fact quite probable that cultivation or change of climate may cause the hydrocyanic acid content to vary.

The composition of tapioca, the form in which we know cassava starch, is, however, of more importance.[4] This food is extremely rich in starch, of which it often contains 85 per cent. It is poor in protein and other nutrients.

[1] Manufacture of Starch from Potatoes and Cassava, Bur. of Chem.

[2] Cassava, U. S. Dept. Agri. Bur. of Chem., 28, 44 and 106, Bull. No. 58.

[3] Food Products of the World, Green, p. 200.

[4] Mandioca of Brazil, Com. Reports, 1915, p. 232–236.

Tapioca as Food

Liberia, the national dish of the natives is "dumboy,"
is prepared from the cassava. The roots are boiled, the
l fibers removed, and then the mass is beaten in a wooden
r with a heavy pestle. This operation which takes about
quarters of an hour, is very laborious, and requires con-
ble skill, as the operation must cease at just the right time.
umboy is eaten with a soup having as a basis some kind of
and in which a variety of vegetables is used. It is said that
e must be cultivated for this dish, but that when this is once
ed the food is more and more enjoyed. In Sierra Leone a
alled "fou fou," which is entirely different from "dumboy"
te and appearance, is prepared from the cassava.[1] In
Cassava is known as "Manioc," and may almost be called
tional food; the powdered root is called "Farina." In Peru,
Cassava is almost a staple food, it is known as "Juca."
thorities differ somewhat as to the digestibility of tapioca.

manihot as it is called in many countries, varies with the variety. Some of the samples grown in Florida contained 25 per cent. of starch, or somewhat more than potatoes. An adulterated product made from potato starch is sometimes sold for tapioca.

Manufacture of Commercial Tapioca

To prepare the tapioca, of commerce, the root is grated or ground with water, the cellulose and unground portions separated by filtration through cloth and the liquid is then allowed to stand at rest for a time to deposit the starch. While the starch is still moist, it is gradually heated until the starch granules are to some extent ruptured and the mass is agglutinated and rather firm, the heat is then continued until the moisture is nearly all expelled.

FIG. 29.—A sago palm, Bermuda. (By permission, Central Scientific Co.)

This completes the expulsion of the hydrocyanic acid. By subsequent operations the tapioca of commerce is prepared for the market as "pearl" tapioca "flake" tapioca and tapioca "flour."

The amount of sago and tapioca, &c., imported into the United States in 1919 was nearly 100,000,000 lbs.

ed in cases of dyspepsia. When made into a jelly it keeps r without fermentation than any other of the starches.

rrowroot lends itself readily to adulteration with other hes, especially that of the potato, and only by the use of the oscope can this fraud be detected. In those countries where ows with little cultivation, viz., Jamaica, Bermuda, East s, Australia, South Africa and Madagascar, arrowroot is a important article of food.

ARTICHOKE (Jerusalem)

(Helianthus tuberosus)

he artichoke, a tuber of the sunflower family, is indigenous to da and the northern United States. The name "Jerusalem" is a corruption of the Italian *girasol*, meaning sunflower. It was introduced into Europe in 1616. Although grown

grown and relished in nearly every part of Europe, and was early introduced into the United States.[1] One variety at least is a native of Great Britain and grows wild in the fens of Lincolnshire and the seacoast of Cornwall. It can be readily raised in any well-drained fertile soil throughout the temperate zone; in the United States it grows as far south as Charleston, S. C.

Asparagus is propagated by setting out the one-year-old "crowns" or plants, or by sowing the seed. A bed once started, and kept well manured will continue to produce an abundance of "spears" or stalks for fifteen or twenty years. It is of great importance in growing asparagus, that the bed have an abundance of sunshine throughout the entire day.

In preparing the young shoots for the table they are thrown into boiling water previously salted, and boiled for about twenty minutes—the time of cooking being dependent on whether they are tender or old and wilted. If cooked in this way the water in which the asparagus is boiled should be concentrated, and used in making a sauce, thus retaining the flavor and the nutrients. The best flavor is obtained if asparagus is cooked within twelve hours after being cut, for if allowed to wilt, or become stale, as is often the case before it reaches the consumer, the flavor is injured. Asparagus served with a thickened dressing on toast is an extremely appetizing and wholesome dish.

Asparagus can readily be preserved by canning, and this is an important industry in some parts of the country. If not "processed" at a sufficiently high temperature, as is sometimes the case in household canning, there is more danger from *botulinus* than with most foods of this class. (See discussion on p. 285.)

Composition of Asparagus

Asparagus contains 0.4 per cent. of a peculiar crystalline amide principle, called "asparagin" ($C_4H_8N_2O_3$) (also found in the potato) which has aperient and diuretic properties. It is also

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[1] U. S. Dept. Agri. Farmers' Bull. No. 61.

ed to act a useful part in the intestine by limiting putre-
n, and so sparing proteins from destruction.[1] Within a
hort time after asparagus is eaten, it will be found that the
ion of the kidneys possesses a strong, disagreeable odor.
s caused[2] by a volatile sulfur product called methyl mercap-
which is formed in the intestines during digestion, and is
ard excreted.

e food value of asparagus is low, as it contains about 94
nt. of water. It should be said, however, that the edible
n contains more protein than most roots and succulent vege-
. On account of its delicate flavor, its appearance in the
spring, and its ready digestibility, asparagus is much
ned, and is every year more extensively grown in the United
. A small unbleached variety is often grown in Europe.
l stalks, hop sprouts, and bamboo shoots are used in some
ries in the same way as asparagus. (See p. 180.)

BEETS (Beta vulgaris)

table, the garden beet contains about 12 per cent. of solid matter, which is somewhat low in protein while the sugar, starch, etc., amount to about 8 per cent. Of the total nitrogenous matter only a small fraction is protein, the greater portion being nitrates, etc. Beets are often served with vinegar which assists in softening the fiber, and does not interfere with the digestion of other constituents.[1]

Cooking Beets

Even more than other vegetables, beets lose a large per cent. of their nutritive material on boiling, since such a large portion is soluble in water. This loss can be reduced somewhat by being careful not to break the skin, and especially not to cut off the root ends and the leaf stalks close to the root. The loss may be further diminished, as in the case of other vegetables, by steaming instead of boiling.

The beet is grown readily for domestic use throughout a wide latitude from the tropics to the north, but the belt in which a high sugar content may be produced is comparatively narrow. (See Sugar Beet, p. 105.) The *mangel-wurtzel* is very similar to the sugar beet, and is grown mostly for cattle food.

CABBAGE (Brassica oleracea L.)

There are numerous plants of the cabbage family, the Cruciferæ, that are used as food, largely, no doubt, on account of their agreeable flavor and their succulent character. This plant was probably first cultivated by the Germans or early Saxons, and was in common use in Greece and Rome in early times. Its acceptance was rather slow in Great Britain, but when once introduced it soon became a favorite food, especially with the Scotch and Irish. Cabbages seem to have been evolved by natural or artificial selection from the wild "coleworts," or "collards," that grow on the seashore in many countries. These plants stand

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[1] Foods and Dietetics, Hutchinson, p. 235.

n the class of "protective foods." They are also important
se of their antiscorbutic or scurvy preventing action.
g plants, grown in a hot bed, are set out in the early spring.
eaves rising from the root stalk are gathered together to
a compact head, and as, in this way, the light is excluded
become white from lack of chloryphyl, and are crisp and
r.

Composition

course, cabbage leaves cannot have a high nutritive value,
y contain 91 per cent. of water, but there is some sugar and
present, and another valuable constituent is the protein,
is proportionately rather high. The value of the calcium
ounds should not be overlooked, as they probably give the
ge antiscorbutic and bone-building properties. Cabbages
in some sulfur compounds, so that the water in which they
iled has a disagreeable odor, and the volatile substance given

cabbage is the name applied to numerous varieties which have crimped or curled leaves.

Sauerkraut

The principal method of preserving cabbage is in the form of sauerkraut, originally a German dish, but now extensively used in the United States. In this process, which is in fact a kind of ensilage applied to human food, the cabbage is packed in casks with salt, and the mass is pressed so that some of the juice is squeezed out. After standing for some time a kind of fermentation takes place in the cabbage and various organic acids are developed which impart to the product a flavor much prized by those who have acquired a taste for it.

One of the characteristic national dishes of Russia called "sktshi" is made by packing chopped or sliced cabbage into barrels with vinegar and salt, and allowing it to ferment. This is made into a broth with meat and forms an important part of the daily food.

Cauliflower

The cauliflower is a variety of cabbage much more delicate in flavor and more digestible than the ordinary cabbage. The edible portion consists of the inflorescence altered by cultivation. It was first grown in Italy and was introduced into England from the continent early in the seventeenth century. *Brussels sprouts* is a variety of cabbage having blistered leaves and the stem of the plant covered with small heads of cabbage, which are the edible portion of the plant, and are considered even more delicate in flavor than the cauliflower.

CARROT (Daucus carota)

The carrot (along with celery, parsnip and parsley) belongs to the natural order Umbelliferæ, and like them contains an essential oil that gives it a strong characteristic flavor. Carrots are common er Europe and western Asia where they have been cultivated ,000 years. It is said that during the reign of Elizabeth[1] ultivated root was introduced into England. It has been fied from the wild variety so that it is now a thick succulent wish red root. It is in more common use in Europe than in nited States, and like many strong flavored plants seems to ted only by those who have cultivated a taste for it.

Composition

arrots are somewhat richer in nutrient matter than turnips ey contain nearly 12 per cent. of solid matter. About half s is sugar (sucrose and levulose). The outer layer contains derable pectose. This root also contains a peculiar ruby rystalline substance, without taste or smell, called "carotin." bout 30 per cent. of the nutrients is dissolved out when ts are boiled in a relatively large quantiy of water.[2] Carare grown quite extensively as a cattle food while their

Its Spanish name is gumbo. In appearance it is much like the cotton plant, and the young pods which are used especially for flavoring soup are the edible portion. It is grown from the seed, planted in rows or in hills like corn. In order to preserve the okra for use throughout the year a special variety, known as *petite gumbo* is grown, strung on strings and dried; when larger varieties are to be dried, they are first cut into slices crosswise, and then strung.

Cooking

No copper, brass or iron cooking vessels should be used in cooking okra, as these discolor the pods. The green pods are often stewed and served like asparagus. Although containing only about 8.5 per cent. of nutriment, including starch, sugar and proteins, this vegetable has come into favor, especially with the Creole cooks of the southern United States; where their "chicken gumbo" has long been a favorite dish. Not only is the soup flavored by the use of this pod, but a mucilaginous consistency is imparted to the product.

ONION (Allium cepa L.)

The onion a plant of the lily family, although possessed of a strong odor, which to many is disagreeable, is very highly valued, especially for the flavor which it imparts to other foods. *Garlic*, *shallots*, *leeks* and *chives* are other condimental foods of the same kind. The use of the onion dates back to the earliest ages of authentic history. Its original home was probably in southern Asia or in the countries surrounding the Mediterranean Sea.[1]

It is said that the onion was worshiped in Egypt before the Christian era, and it was used in the ancient Druidic worship in Great Britain. It is readily grown from the seed, or "onion sets" grown the previous year may be planted. The entire plant of the young onion is often eaten. A peculiarity of some plants, like onions and asparagus, is that they grow readily in soil con-ıg considerable common salt. They are also grown best : there is an abundance of moisture. Onions to be stored d be dry and thoroughly cured. They are often cured anding in bags in the field. They require a low temperature above freezing) and a dry air, with good ventilation in order ep well.

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[1] U. S. Dept. Agri., Farmers' Bull. No. 354.

Composition

lants of the genus *allium* are peculiar in containing an acrid ile oil (allyl sulfide) $(C_6H_{12}S_2)$ to which many of the charac- ic properties are due. They contain from 10 to 15 per cent. trients, including dextrose and levulose, and a small amount otein. Garlic is especially rich in a peculiar mucilage.

nions may be cultivated over large areas in temperate and tropical climates. The bulbs grown in the southern coun- as in Spain and Portugal, are imported to Great Britain, and : shipped from Bermuda to the United States, are con- ed as of more delicate flavor than those grown farther north.

root of the parsnip is not injured by the frost, it may be left in the ground all winter. It is usually grown in a single season and the smaller roots are more tender and better suited for human food, while the larger and more woody roots are excellent as a cattle food.

Composition

The parsnip contains considerable nutritive material of the sugar-starch group, and about 80 per cent. of water. It is unique in containing more fat than other vegetables of this class, viz., 0.66 per cent. It is therefore a somewhat better food than the turnip and the carrot. Pectose and cellulose are found to quite a large extent, but there is only 1.3 per cent. of protein present. The parsnip has such a strong flavor that it is not liked by all persons. On account of containing from 13 to 14 per cent. of carbohydrates, a wine of excellent flavor is made from the juice of the parsnip in Great Britain and the fermented and distilled juice yields a potable spirit.

RHUBARB (Rheum raponticum)

Rhubarb which belongs to the Buckwheat family, often called "pieplant" or "wine plant," is used in the spring for making pies and sauce. The thick petioles or leaf stalks are utilized for this purpose. The plant, although indigenous in portions of Asia, is said to have been brought originally from the vicinity of the Volga River and was first grown in England in 1573. In Germany it is cultivated both as an ornamental plant, and for food purposes. The plant is readily grown as it is a perennial, so that the roots once started annually produce an abundant crop.

Composition

Although the stem contains considerable fiber, it is made soft by cooking. It contains a large amount of acid potassium oxalate

ıcid calcium oxalate, and on this account requires an abun-
e of sugar to make it palatable. As the rhubarb contains
92 to 95 per cent. of water, its nutritive value is not usually
dered, although it is interesting as containing 1.19 per cent.
t,[1] which is more than is ordinarily found in vegetables of
lass, and 2 per cent. of sugar.

he rhubarb has some medicinal qualities, and acts slightly
axative. In case there is a tendency to certain diseases such
ut and rheumatism, this plant should not be used as food.
ould be noted that the plants Rheum officinale and R. pol-
m, the rhizomes of which are used in medicine under the
rhubarb, belong to the same family.

esides its use as food, rhubarb is of value for making a wine
h has a characteristic flavor highly appreciated. For this
ose it is only necessary to express the juice, add sugar, and
it to ferment.

SALEP (Orchis masculata)

SWEET POTATOES (Ipomea batatas)

The sweet potato is a plant which belongs to the order Convolvulus (Morning Glory) and is probably a native of tropical America,[1] although it was known in England before the introduction of the Irish potato. The sweet potato grows best in a climate where there are at least four and one-half months without frost, and in moderately fertile, sandy loam. When grown near the northern limit of latitude, where the nights are cold, it is not as sweet nor of as fine flavor. The commercial crop is grown mostly from cuttings started in a bed or from the potatoes cut in pieces as are white potatoes. The portion used as food and which is in reality an enlarged root (stock) may be referred to as a tuberous root. As ordinarily planted, the vines at maturity cover the whole surface of the ground.

Sweet potatoes do not keep as well as Irish potatoes and they are also subject to various diseases. For keeping they require a warm dry atmosphere, therefore they are best kept in the North under conditions similar to that of a rather cool dwelling and in the South in pits or out-of-door cellars, which must be well ventilated.[1] They keep best in a room where the fluctuation in temperature is not over 5° either way from 54° F.

Composition

The sweet potato contains from 4 to 6 per cent. of sugar and usually over 20 per cent. of starch. Most of the sugar is sucrose; but there is an appreciable amount of non-crystallizable sugar. The quantity of sugar increases and the quantity of starch diminishes on storing, just as is the case with some fruits.

Cooking Sweet Potatoes

On account of its composition, the sweet potato is not so readily cooked so as to be "mealy," but is liable to be heavy or "sodden."

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[1] U. S. Dept. Agri., Farmers' Bull. Nos. 129, 295, 234. 410.

therefore not so suitable a food for invalids as is the white o. Steaming develops the flavor of the sweet potato better boiling, and baking is a still better method of cooking. One iarity in the cooking of sweet potatoes is that they should oked slowly and for quite a long time. An hour in the oven too long to develop the best flavor. While in most countries egarded as a vegetable, in some parts of Asia it is preserved sweetmeat. Canned sweet potatoes are rapidly coming into , as this is a practical method for keeping them for use at all of the year.

nce the sweet potato is deficient in both protein and fat, eanuts are rich in both these nutrients, a well-balanced ration, ell as an agreeable food, is made by a judicious mixture of potatoes and peanuts.

veet potatoes are used with success for the manufacture of ol as both the sugar and starch are fermentable, but they are considered as valuable for this purpose as are the Irish oes.

sweet potato although it is usually not so sweet. It often grows to great size (up to 30 pounds) in the East Indies, though under these conditions the flesh is somewhat tough and coarse.

Sweet potatoes and yams are used for making a sirup by treating with malt so as to change the starch to sugars (See p. 138.) A sweet potato flour is also made.

TARO (Colocasia antiquorum, esculenta)

The rootstock of the taro which grows throughout the tropics is cultivated for food in China, Japan, and the Islands of the Pacific. The acrid root is made edible by heating or boiling. This vegetable is something like the yam and the sweet potato in appearance, and is used as potatoes are commonly used in the United States. These tubers contain about 18 per cent. of starch, 1.75 of sugar and 1.80 of total protein, and so are similar in nutritive value to the potato.

"*Poi*" is the name applied by the natives to the starch made by washing the roots and grinding them to a meal. It is often allowed to ferment during the process of manufacture. For making a porridge, it is stirred into hot water to the thickness of a paste and is not only a valuable food, but an excellent diet for invalids.

DASHEEN (Araceæ)

The dasheen[1] is a vegetable resembling the elephant ear or the Hawaiian taro, which may be readily grown in semitropical climates, where there is an abundance of moisture. (Fig. 31.) It is a staple food for millions of people in tropical countries. The tubers are similar in composition to the potato, but contain more starch and protein. They have a flavor when cooked by boiling or baking which suggests boiled chestnuts. They have been successfully raised in the United States, in South Carolina and Florida.

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[1] Circ. U. S. Dept. Agri., Bu. Foreign Plant Introduction.

Turnip (Brassica napus)

e Turnip belongs to the order of *Cruciferæ*, so named because four petals arranged like a cross. It has been cultivated he days of the Greeks, and grew wild in many countries. ssia turnips are often classed as a luxury, and are sometimes raw as a relish, in fact, this method of eating them is not y unknown in the United States and Germany. The Lap- s are also said to be exceedingly fond of this vegetable.

the turnip grows late into the autumn, it is often sown after ting some earlier crop.

milk. Their most important use is for feeding stock, although they communicate a valuable variety to human food. They have not received as much attention with reference to improvement by cultivation as has the sugar beet.[1] Rutabagas are fed to stock.

MISCELLANEOUS VEGETABLES

Other vegetables used in some countries are "arrowhead" tubers, some kinds of which were used by the American Indians, and others by the inhabitants of China and India; lily bulbs, which are used as food by the Chinese and other Asiatic races; water-lilies, the roots of which were used by the Ancient Egyptians and the roots of the lotus which are used by the people of India, China and Japan.

OTHER "GREENS"

In addition to the vegetables already mentioned, a large number of other plants often called "pot herbs" are used as food. That the leaves and stalks of young plants contain valuable food substances is shown by McCollum,[2] who states that the leaf is a very different thing from the seed from a dietary standpoint. The leaf supplements the inorganic deficiencies of the seed, and at the same time contains much more of the dietary essential, fat-soluble *A* (See p. 26) than does the seed. Greens are of comparatively little value as far as their nutritive quality is concerned, but they furnish abundant mineral salts such as the chlorides, sulfates and phosphates of sodium, potassium, iron, calcium and magnesium. Some of these vegetables are of positive value in the relief of chronic constipation and indigestion, and all are to be recommended as furnishing an agreeable variety to the food in spring and early summer, as they also serve to stimulate the appetite, distend the alimentary canal and make alkaline the blood that winter foods tend to make too acid. They sually boiled and sometimes afterward chopped and served hard-boiled eggs.

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[1] J. Soc. Ch. Ind., Vol. 16, pp. 213–219.

[2] The Newer Knowledge of Nutrition, p. 43.

mong the important food plants of this class are: kohl-rabi rnip cabbage, which has the stem, the edible portion of lant, largely developed above the ground; kale, called also ole, savoy cabbage, broccoli, sea-kale and "colewort" or rds.'"

her vegetable substances of this class are spinach, one of the valued, beet tops, dandelion tops, narrow-leaved dock, tops, stinging nettle, swiss chard, plantain leaves, purslane sley"), mustard, poke sprouts, dasheen leaves, pigweed, weed, and milkweed sprouts.

SALAD PLANTS

lads are cold dishes, composed of either meat, fruit, nuts, r vegetables. They are served either with mixtures of oil inegar or lemon juice, or with oil, egg and vinegar.[1] The oil, am which is sometimes used, is a valuable nutrient, and should

It has been well remarked that too great care cannot be exercised in the thorough cleansing of such leaves and stalks as are selected for making salad, as this is the only precaution that can be exercised to prevent the introduction of worms and other small organisms into the body.

ARTICHOKE (Cynara scolymus)

The green or true artichoke, which belongs to the thistle family, is cultivated for the sake of its immature flower heads, (Fig. 32) which are served either raw as a salad, or cooked in water or milk and served with a sauce. It is in common use in central and southern Europe, where it is much more appreciated than in the United States. Canned artichokes are exported from Italy and France. When the leaf stalks are blanched by tying them up the term "chard" is applied to the white and tender leaves. (See p. 164.)

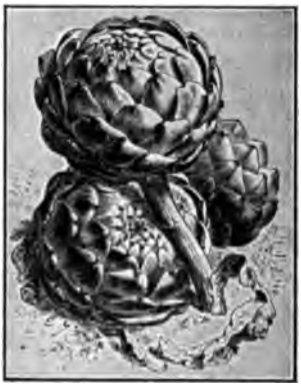

FIG. 32.—Artichokes.

CELERY (Apium graveolens)

The celery, which belongs along with some other edible herbs, to the Umbelliferæ, has within recent years come into considerable commercial importance. The wild celery[1] is a native of the marshes of southern England, and many parts of the Continent. From England it was brought to the United States and one variety known as "smellage" or "smallage" was for many years cultivated in the old gardens for its foliage and as a salad plant. Since, however it belongs to the same family as the poison hemlock, it was by many considered poisonous to eat. Gradually, since the middle of the last century, it has come into common use in the

[1] U. S. Dept. Agri., Bull. No. 282.

l States and is at present regarded as an extremely valuable on to our supply of foods and condiments.

e celery is a biennial, and produces its seed the second year, which the plant dies. The first season after the seed is is used in building up an abundant storehouse for starch ther carbohydrates, so that it may be utilized the second the production of flowers and seed.

Growing Celery

the United States there are two areas where celery may be with profit, viz., a northern area where it grows well in mmer, and a southern area where it can be grown during the winter months. It does best in a rich, mellow, sandy loam, and heavy manuring is necessary for a good crop. Usually the seed is sown in a hot-bed, and the young plants are set in rows as soon as

especially, the roots of one variety known as "*celeriac*" are boiled and eaten like turnips, or served cold with dressing as celery root salad. (Fig. 33.)

Composition

Celery contains about 6 per cent. of proteins and carbohydrates, including 2 per cent. of sugar. Its taste is due to the presence of a very small quantity of essential oil. It is regarded by some as possessing certain valuable medical properties, but its value as a food accessory is largely due to the fact that it can be obtained when other green foods are not on the market, that it has an agreeable flavor, and that it dilutes the more concentrated forms of nourishment. "Celery salt" made from the ground seed is much prized for flavoring soups and salads. The outside stalks which are usually tough are often boiled and then the water in which they are cooked is strained and made into cream of celery soup.

In the United States celery is grown most extensively for the market in the drained "muck bed" areas of the Great Lake region and in Michigan, Ohio, New York, California, and Florida.

CHICORY (Chiconium intybus)

The chicory is closely related to the endive and dandelion. (Fig. 34.) The leaves have a rather bitter taste but are used in salads. Under cultivation the large root which is developed is used after roasting for adulterating coffee or as an important constituent of a beverage of this class. (See Coffee, p. 474.) Much of the chicory used in the United States is imported, and for a part of the time during the World War, it actually cost more than coffee in New Orleans, where it is an essential ingredient of "drip coffee."

ENDIVE (Chicorium endivia)

The endive sometimes called winter lettuce belongs, as does ordinary lettuce, to the same family as the dandelion. It was

ultivated in China and Japan, and is found wild in all coun-
urrounding the Mediterranean. The blanched leaves are
rtion used, and although they would be acrid and tough if
d to the air, the process of blanching makes them crisp and
. This plant will also bear a comparatively low tempera-

in great esteem by the ancients. In 1520 it was introduced into England from Flanders. There are many varieties, some of which are spreading, and have large succulent leaves, while in others the leaves are drawn together similar to the cabbage and are crisp and nearly white. The varieties may be classified as (1) cabbage or head lettuce, (2) "Cos" or leaf lettuce, named from the Island of Cos, near the coast of Greece, and (3) cutting lettuce from which the leaves are cut as they mature.

There is not much food value in the lettuce, although its mineral salts may be of use in the processes of metabolism. Some ascribe medicinal virtues to the lettuce on account of its containing a small quantity of a sleep-inducing substance called "lactucarium" which is found more abundantly in the stem. Others have recommended it[1] for supplying iron in the organic form, as some believe this element is in this plant chemically combined in the chlorophyl. As a wholesome, cooling, agreeable salad plant, lettuce has always been a favorite throughout temperate and semitropical countries.

RADISH (Raphanus sativus)

The radish, although its root is the part generally used, may be classified here, as it is seldom eaten in any other way except raw and as a salad. This plant was originally grown in India, and later introduced into Great Britain and the United States. Many of the edible varieties are small and quickly grown; but large radishes are also used. One of the winter radishes, a Japanese variety, sometimes attains a length of 2 feet, and is a foot in diameter. It is commonly cut in chunks and pickled in brine. The radish has a somewhat pungent taste, and is valuable as an antiscorbutic.

MISCELLANEOUS SALAD PLANTS

Other salad plants are the cardoon, which is something like the artichoke, the leaf stalks of which are blanched like celery, h is eaten as a vegetable in soup or as a salad. It grows in the tries which surround the Mediterranean. The tender leaf s of several varieties of thistle are used as food in some coun- and the young leaves and stalks of the mallow. The finochia t fennel) is a favorite salad plant in Mexico. The stems are hed like celery.

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[1] Human Foods, Snyder, p. 42.

ther plants of this group, some of which have vegetable acids sential oils which give them a characteristic flavor, are borage, t, cress, water-cress, cowslip, corn salad or Lamb's lettuce, , chevril, mint, nasturtium, parsley, pepper grass, peppers n), sorrel and tarragon.

AROMATIC AND MEDICINAL HERBS

he following aromatic and medicinal plants, although not prop- elonging to the class of foods, are often used in foods for flavor- r garnishing, and may be grown in the vegetable garden: (seeds), balm (leaves), caraway (seeds), catnip (leaves), cori-

CHAPTER VII

LEGUMES (Leguminosæ)

The **legumes**,[1] or **pulses**, as they are called in England, stand next in importance to cereals among vegetable foods. They include beans in great variety, chick peas, peas, lentils, peanuts and a few other plants. They have been in use for so many hundreds of years and in so many countries that their origin is lost in antiquity. In China, India, northern Africa and other countries bordering on the Mediterranean Sea, they have formed an important part of the food of the common people for centuries.

The plants of this family all have a characteristic papilionaceous or butterfly-shaped flower, and the seed grows in pods, containing sometimes few and sometimes a large number of individuals. Many of these plants are broad-spreading trees, which yield fruit entirely inedible for man, but most of those bearing edible fruit are low and herbaceous.

Perhaps the most interesting characteristic of the family is, that many of the plants not only furnish a valuable food, but at the same time actually increase the fertility of the soil in which they are grown. This is due to the fixation of atmospheric nitrogen by the bacteria working unceasingly in the laboratories of the root nodules. It is only within the last sixty years that these facts in regard to the soil-fixation of nitrogen[2] have been understood, although the practice of plowing under cow peas, clover and similar crops has been common for many years.

Beans and peas mature rapidly, and therefore can be grown in the northern countries, as three or four months only are needed to bring them to full maturity. They are cultivated as garden

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[1] U. S. Dept. Agri., Farmers' Bull. No. 121.

[2] U. S. Dept. Agri., Farmers' Bull. No. 315.

and have the advantage of not requiring any special kind
and indeed they will not refuse to grow and produce a fair
n comparatively poor soil. This is largely due to the fact
hey can avail themselves of a double supply of nitrogen—
hich is contained in the soil as nitrites, nitrates and am-
, and that which is collected from the air by the root nodules.
ce **protein food** is usually expensive it would seem that in
and other legumes we have found a cheap and abundant
of this kind of nutrient, and to a certain extent this is true,
eans have been extensively utilized for this purpose. It
ns, however, that the protein exists in the legumes in the
f legumin with but little albumin. As has been pointed out
it, vegetable foods in general are less completely digested
nimal foods, and this legumin is acted on mainly by the
nts which work in alkaline solutions, especially in the lower
f the alimentary system. On this account, then, beans are
adily digested in the stomach, although they are absorbed by
testines

The flatulence that is often occasioned by the use of a diet consisting largely of beans is probably caused by the breaking up by bacteria in the intestine of the germ of the bean, giving rise to a considerable quantity of the hydrocarbon, methan (CH_4). The abundant sulfur found in the protein of beans may also have something of the same effect.

Legumes as Food

It is true that beans form an admirable and cheap addition to the food of persons engaged in manual labor, and persons exposed to severe weather, for in lumber camps and mining regions they are used in great quantities and with little discomfort. Under such conditions, a pound of baked beans per person a day produces no ill effects. People of sedentary habits, however, are not able to digest large quantities of leguminous foods, and whenever these foods are used an abundance of other nutrients should be eaten at the same time.

Says Hutchinson, in speaking of the pea and bean,[1] "As a cheap and efficient method of supplementing the deficiency of nitrogen in a purely vegetable diet, however, their use is strongly to be recommended, and it is a pity that they are not more largely taken advantage of by those to whom economy is of importance, for unquestionably the pulses are among the cheapest of foods, and a given sum will yield more protein, if invested in these, than in any other way." As the legumes when ground into flour furnish a more digestible food than when used whole, it is rather remarkable that this product is not more generally placed on the market.

BEANS

The bean on account of the numerous ways in which it can be prepared for food, and because it is so readily grown, is one of the

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[1] Food and Dietetics, p. 224.

mportant of the legumes. It is believed that beans were
ted by the Indians of both North and South America,
e read of the Algonquins having one or two varieties of pole
Champlain speaks of planting the "Brazilian bean"
region of the Kennebec, and bean flour is mentioned as
been in use among the Aztecs.

ans may be grown for use as "snap" or "string" beans, as
r green beans, or they may be allowed to dry and be kept for
use. For the latter purpose very large quantities are grown
mmercial scale in the United States and abroad.

Composition

e amount of starch and protein in some of the common edible
is as follows:

	Carbohydrates	Proteins

similar to that used for sauerkraut, occurs. They are then soaked out and freshened with water before using.

Shell beans, which must also be fresh, should not be overcooked, or they will lose their fine flavor and become yellowish brown. The addition of butter, after the vegetable is cooked, improves the flavor and increases the food value of the product.

Lima beans and kidney beans are often put upon the market canned, but the greatest demand is for "baked beans," which are frequently flavored with "tomato sauce," molasses, pork, etc. It is a question whether some of the so-called "baked beans" on the market should really bear this label, as the product differs so decidedly in method of preparation and quality from the domestic article.

In the *cooking* of dried beans it is advisable to use a little baking soda in the water, as some of this enters into combination with the legumin and renders this substance more digestible. It is the common household practice to soak the beans for at least eight hours before boiling. The food is made more digestible if the skin which contains much indigestible cellulose is removed before cooking. This can be readily done by boiling with a small amount of baking soda, and then washing in cold water. The main requirements for cooking dried beans are, to soften the cellulose so that the beans can be easily masticated and thus render them more accessible to the digestive enzymes, to so cook the protein as that it shall be digestible and palatable, and finally to swell the starch grains.

Experiments show that soft water is much more suitable for use in cooking beans and other legumes than hard water; rain or cistern water is the best, although of course there is no objection to the use of distilled water. The reason for preferring soft water is that the lime of hard water forms insoluble compounds with the proteins of the legumes, and then no amount of cooking will soften them.

It has been universally conceded that long cooking at a moderate temperature develops the flavor of beans and most effectually

ns the tissue. This is illustrated by the delicious flavor of
d-fashioned "pork and beans" of New England, which was
ht to perfection by baking for at least twelve hours in the
ooking brick oven. The addition of fat, as salt pork, not
improves the flavor, but supplies needed ingredients to
a better balanced ration.

ma beans (p. lunatus), both pole and dwarf, are favored
dietary, on account of their size and flavor. They are
ally used in making the well-known North American Indian
called "succotash." (See Corn, p. 47.) A variety of the
y bean very extensively grown, and used especially in France,
wn as the haricot or in the United States as the "navy bean."
arge yellow bean grown in Italy forms such an important
of the food that it is cooked and exposed on the streets for
The broad bean (Vicia faba), which is one of the oldest
se leguminous plants known, grows well in the northern
d States and in Canada, and is an important crop in Europe.
not so well suited to countries liable to prolonged rainless

Preparations from the Soy Bean

One variety of soy bean analyzed[1] contains:

Water	9.80
Protein	37.13
Carbohydrates	24.40
Fat	18.36
Lecithin	1.62
Crude fiber	4.47
Ash	4.30

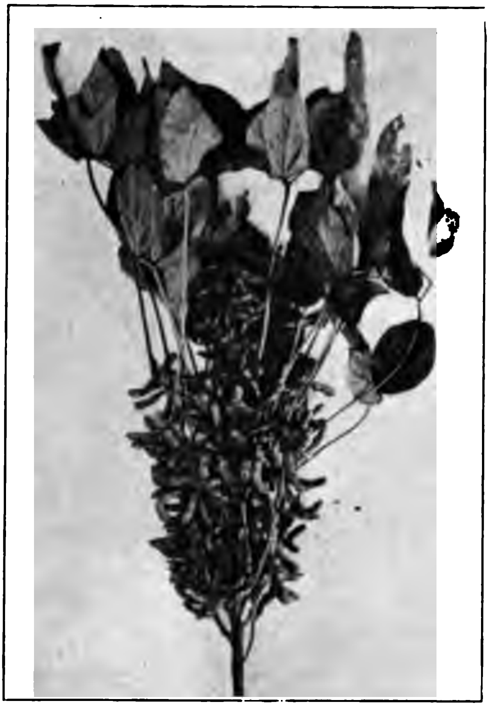

FIG. 35.—Typical soy bean plant. (By permission U. S. Dept. Agric.)

In China, Manchuria, Korea and Japan the soy bean supplements very well the rice diet of the natives, as it furnishes both protein and fat in which the rice is so deficient. This is especially

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[1] Chem. Abs., Vol. 2, p. 864.

se in those districts where fish are not available at a moderate
In the last war between Russia and Japan soy beans were
ief food-stuff upon which dependence was placed.[1] A sauce
"soy sauce," having a pungent and agreeable taste, is
by fermenting for several months with a special ferment a
re of cooked soy beans, roasted wheat flour and salt. Other
inous products often called "bean cheeses" are used in these
ries. "Natto,"[2] is made from the boiled beans packed
straw and allowed to ferment. The mass becomes white
ucilaginous by the development of bacteria, and the straw
s the product.[3] Other foods are "miso," a fermented product
from beans, barley and salt, and "tofu," which is made by
ng and boiling the beans and filtering through cloth. Two
nt. of concentrated sea brine is added to this, which, probably
ount of the calcium and magnesium present, precipitates the
casein, which is then pressed into white tablets. Soy milk
de by boiling the beans, and beating to a pulp, when
of the vegetable casein passes into solution, and a milky

larger cities of the United States. It comes originally from Syria and on the shores of the Mediterranean is grown as food for cattle. This bean was much in favor among the Arabs, who extended its growth as far as Morocco and Spain. It appears in all the central European fruit markets. The ripe seeds are surrounded by a sweet mucilaginous mass, which is, however, by some appreciated more as a confection than as a food. The dried pod yields 50 per cent. of sugar. The Carob bean can readily be grown in southern California and in other semi-tropical areas in the United States. That there is a large demand for it is shown by the fact that it is imported in from 30 to 300 ton lots. In the United States it is used for stock feed.

Other Beans

Another bean of local importance is the Frijole, largely grown and used as a staple food in Mexico and the Southwest. In fact next to corn (maize) this bean forms the principal part of the diet of a very large population. The beans are small, flat and usually of a reddish-brown color and are extensively used as "snap" or string beans.

Tamarinds

The *tamarind* (Tamarindus indica) is the pod of a leguminous tree growing in tropical Africa, the East and West Indies. The name in Arabic signifies "Indian date." The seeds are used as an astringent, the leaves to furnish a dye stuff, and the wood for timber. The beans are surrounded, inside the pod, with a dark-colored pasty material, which is the edible portion of the fruit. This has a pleasant sweetish-sour taste, and by analysis is shown to contain 82 per cent. of total solids, 15 per cent. of acid, mostly tartaric, and over 40 per cent. of reducing sugar. In fact, it contains more sugar than the sweetest fruit, and more acid than the sourest fruit. The large amount of sugar is not, however enough to entirely mask the effect of the acid, and the taste

ctly sour. On account of this peculiar composition tama-
are used to make cooling, sub-acid beverages, especially for
ids. The fruit is official in the Pharmacopoeia as a laxative
efrigerant. Tamarinds are preserved either by the addition of
nd drying in the sun, or by putting in jars and covering with
sirup. Tamarind paste, which is a mixture of the pulp and
75 per cent. of sugar, is a valuable commercial product. By
g an ounce of the tamarind pulp with about 1 1/2 pints of warm
a nourishing beverage, called "tamarind whey," is obtained.
oung pods are sometimes cooked with rice and fish.[1] The
inside the pods is in some countries sold in balls weighing about
ces, and these are used for making a laxative beverage. The
is also used to adulterate guava jelly, but this substitution
e readily detected by the presence of tartaric acid in the prod-
s this acid is absent from true guava jelly. From tamarind
, an oil may be made which is suitable for use in paint, and
reater drying qualities than linseed oil. The roasted seeds
id to be superior to peanuts in flavor and a valuable food

United States the three most important bean-producing states are Michigan, New York and California, although the crop is readily grown from Florida to Minnesota. The bean crop of 1919 in the United States was 11,488,000 bushels. There were imported into the United States in 1919, more than 2,300,000 bushels of beans. The greatest bean-producing country is Italy, which raised 20,632,000 bushels in 1910. Spain is next in importance producing 13,454-000 bushels the same year.[1]

PEAS (Pisum sativum)

Although it is known that the Greeks and Romans cultivated peas, yet they do not seem to have been in common use as long, nor to have been as universally grown as beans. They were no doubt introduced into Europe by the Aryans, and were first brought to England, where they were regarded as a great dainty, from Holland in the seventeenth century. Peas are more often used when green than is the case with beans, and less so when dry.

Composition

Much that has been said in regard to the growth, composition and digestibility of beans applies equally well to peas. Their composition is as follows:[2]

	Water	Ash	Protein	Fiber	Starch, sugar, etc.	Fat
Green pea....................	79.93	0.78	3.87	1.63	13.30	0.49
Dry pea......................	12.62	3.11	27.04	3.90	51.75	1.58

Comparing this analysis with that of the bean, it is evident that peas, especially when dried, are even more nitrogenous than beans, early all this nitrogenous material is said to exist in the form teins. The protein of peas consists chiefly of legumin, a lin not coagulated by heat, and vicilin.

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[1] Year-book, U. S. Dept. Agri., 1911.

[2] Foods and Their Adulterations, Wiley (2d Ed.), p. 288.

e unripe or green peas are more digestible than are dried nd they contain considerable sugar, which greatly improves flavor. The field pea (pisum arvense) is often grown to h the "split peas" of commerce. In preparing these for t the outer skin is removed, thus increasing the digestibility e product. Pea flour has a considerable sale, especially d, and is used in making soups. The "Erbswurst," so much in Germany, especially in the army, is composed of pea flour, rk and salt and is so nutritious that a comparatively small nt will sustain the men for a long march. This diet, however, le to become monotonous, and to produce irritation in the ntary canal.

Canned Peas

nned green peas are a very important addition to the

Pea Growing

Peas are not grown as far south as are beans, yet throughout the north temperate zone there is a wide area where they are raised, both in the garden and on a commercial scale for the market. In Mediterranean countries, Spanish America and in British India, the chick pea or gram (Cicer arietinum) is extensively used. This is the "garbanza" of Spanish cookery. It is a large pea and grows singly in round pods. Although these peas may be boiled for use, they are more commonly roasted, and still form an important article of food for travellers in Oriental lands. It was perhaps the "parched pulse" of the ancient Hebrews. It is known also as an ingredient of the distinctly Spanish dish "olla podrida."

LENTILS (Lens esculenta)

The lentil is a very ancient food plant, and one of the earliest brought into cultivation. The Bible tells of its use in Egypt, Asia and Mediterranean countries. The "red pottage" for which Jacob sold his birthright to Esau was composed largely of lentils.[1] The European market is even now principally supplied with lentils from Egypt, although they might be readily cultivated farther north. In the preparation for market, the outer skin is usually removed.

With the increasing immigration from southern Europe, where lentils are more used than formerly, they have also become more popular as a food in the United States. In composition the lentil is one of the most nutritious of all the legumes, excepting the soy bean and contains the highest per cent. of protein. According to Church[2] it contains 25 per cent. of albuminoids, etc., 56.1 per cent. of starch and 2 per cent. of fat. Lentils also contain a little sulfur and some varieties are particularly rich in iron. They are considered more digestible than either peas or beans. It is probably on account of the strong flavor, and because other s that are considered more agreeable are so abundant, ntils have not come into more general use among the people northern countries.

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[1] Genesis 25:34.

[2] Food, p. 97.

e favorite method of serving lentils is in the form of in soups and stews. There are at least three varieties, nilar to the common pea, one a larger yellowish variety, and a small brownish or reddish seed, of more delicate flavor. proprietary food known as "*revalenta arabica*," consisting of lentil flour, is found in the market. This may also n ground peas, beans, corn, wheat or barley. According tchinson, analysis showed that this food contained less n than the lentil flour. During Lent the Catholice use in the place of meat, and lentil flour is used by the Hin- when engaged in heavy work, to supplement their diet of Lentils can be readily grown in the southwestern United and Mexico, and their cultivation has already been started section of scanty rainfall, sandy soil, and moderate fertility.

Virginia type, which when roasted contains on an average 44 per cent. of fat, is mostly used for eating, although the smaller nuts are used for making butter; the Spanish type is peculiarly adapted to the production of oil and the best grades are used for the production of peanut butter. It contains 50 per cent. of fat.[1]

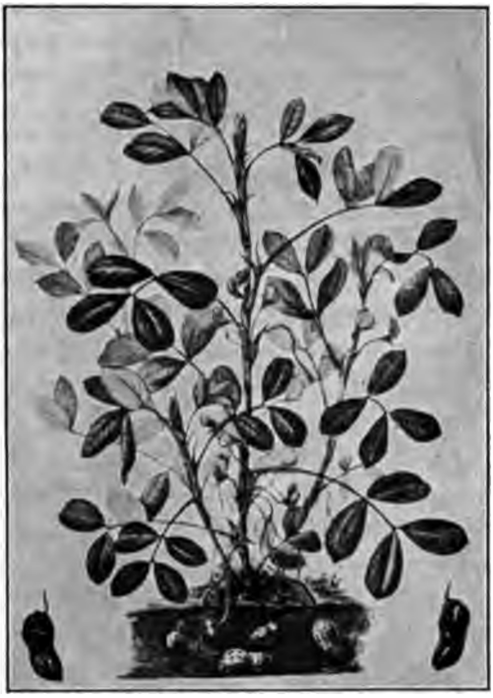

FIG. 36.—The peanut plant, showing the pod growing beneath the surface of the ground. (Wiley.)

Peanut Growing

A word in regard to the way in which this unique pea fruits, may be of interest. The small yellow flowers are borne in a little pocket where the leaves are attached to the stem, and as soon as the flower fades, the elongating stem thrusts the ovary beneath the surface of the soil, where the pod is subsequently developed.

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[1] Y. B. U. S. Dept. Agric., 1917.

nuts grow best on a well-drained, sandy loam, and require season without frost (from ninety to one hundred and days), small rainfall during the growing season, a high ature and abundant sunshine. It should not be forgotten ke other legumes, the peanut is a soil-renovating and a soil- ing plant, because of the nitrogen of the atmosphere col- in the root-nodules. Peanuts are picked from the roots and either by hand or machinery, and are mechanically sorted oroughly cleaned at the factory.

Composition

hough the composition of different varieties differs consider- he average, for the whole nut shells and all, may be stated sisting of protein 26 per cent., oil 38 per cent., and sugar, etc., 24 per cent.[1] They are therefore extremely rich in oil otein.

Use as Food

and puffed rice, as this combination makes a better balanced ration.

The peanut, which is one of the most nutritious foods known to man, has great possibilities for increased use. A pound of peanuts furnishes about 2700 calories, while the same amount of beefsteak yields less than one-third as much. If peanuts are pressed and the oil is extracted, the press cake may be ground into flour or meal which can be used to take the place of a part of the wheat flour in making bread, muffins or griddle cakes.

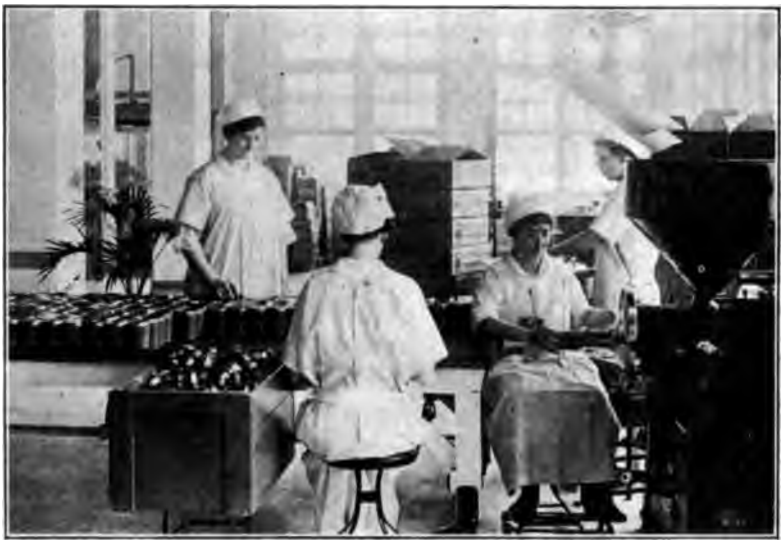

FIG. 37.—Filling peanut butter into jars. (Beech-nut Packing Co.)

Peanut Products

The use of peanut butter and a preparation called peanolia is also on the increase. In the manufacture of these products, the peanuts are carefully roasted, either dry or in hot oil then thoroughly cleaned to remove the outer coating and the germ, and finally ground in a special mill. This product, sometimes fresh, and sometimes salted, is put up in sealed packages or in wooden d placed on the market by the ton. The factory process practically imitated at home by the use of a small meat . “Vegetable meats” are prepared from peanuts by ing some of the oil and adding to the residue various le substances. Peanut meal is largely used in confec-, especially for making imitation almond macaroons, and akes. The oil of peanuts is easily expressed, of excellent high nutritive value, and possesses much better keeping s than some of the other oils used for salad purposes. (See d Oils, p. 313.)

the United States for commercial purposes, peanuts are cultivated in Virginia, Alabama, the Carolinas, Oklahoma and Georgia, but they may be grown throughout the Southtes, and southern Missouri and Kansas, as well as in Cali- Most of the manufactured products, however, come from en states first mentioned. A yield of 50 bushels per acre dered a fair crop. The peanut crop of the United States was 55,507,000 bushels, valued at $95,820,000.

CHAPTER VIII

THE CULTIVATION, PRESERVATION AND USE OF FRUITS AND BERRIES

The culmination of the annual or biennial life of plants is at the time when their seed is produced and ripened for the further propagation of the species. Closely associated with the seed is the pulp or fleshy part of the fruit or berry, which usually is present as a soft, juicy mass surrounding the seed. This is often edible and brightly colored so that it attracts the birds, insects and quadrupeds, who thus assist in scattering the seeds. Primitive man was no doubt attracted in the same way by the color, odor and appearance of the wild fruits, and if the taste proved to be agreeable, he continued their use. Incidentally the fruits appeased his hunger, and soon he used them to sustain life. Some fruits, however, must have produced disagreeable symptoms when first eaten, and some would produce death. In this case the word would be communicated to others that the fruit was poisonous and hence should always be avoided. It was not necessary for primitive man to possess a knowledge of the constituents of fruits, as he was only concerned with the agreeable taste, and their power to sustain life. It naturally follows that the abundance of wild fruits in certain regions at particular times of the year attracted the nomadic people to that locality. When they had harvested these fruits they would move to some other locality to obtain other food products.

As man arose in the scale of civilization he began to study other problems in relation to fruits. He tried to learn whether they might be cultivated to advantage, whether they were liable to be injured by disease or insect pests and what were their keeping qualities. The inquiry would then be pushed still farther so as to hat their nutritive qualities were, and their physiological

emperate climates we are accustomed to regard fruit as an
le addition to the diet, rather than a staple food. In
y oranges, apples, peaches, cherries, grapes and melons are
In tropical countries, however, the fruits are the food, and
tly almost the only food of the natives. Without the
, the bread fruit, the fig, the date and the cocoanut these
could not live so easily, and if they were deprived of their
med fruit diet they would find that much greater labor on
rt would be necessary to obtain food enough to sustain life.
anically speaking, a fruit is the ripe or ripening ovary with
tents and any closely adhering parts. The fruit nourishes
ung seed and protects it during its development. The
portion surrounding the seeds is known as the pericarp.
een fruit does not differ very much from the leaf in com-
n, but under the influence of sunlight in the process of ripen-
ere is a remarkable change in size, color, texture, composi-

Sometimes, it is true, the flavor of fruits and berries has been sacrificed for size, color, texture and abundant fruitage, but this is not usually the case.

That the kinds of fruits and vegetables in use by civilized man has not increased very much is shown by consulting the earlier literature and by inspection of some of the noted paintings of artists of the sixteenth century, like those of Snyder, who has many fruit pieces.

There has been a tendency to eliminate the seeds from edible fruits, as these become unnecessary by the methods of propagation now employed, and their growth may then be considered a "waste of energy" on the part of the plant. The fact should, however, not be lost sight of that the presence of the seed in the fruit may influence the flavor.

By some early natural selection, no doubt, the seeds were practically eliminated from such a fruit as the banana, and the cultivation and propagation of seedless "sports" has been practised in recent times, and has resulted in the production of the seedless orange and lemon, and to some extent the seedless persimmon and other fruits.[1]

Classification

Fruits are for convenience divided into the following classes:[2]

A. *Orchard Fruits.*

1. Pome Fruits.
   Apple (crab apple), loquat, medlar, pear, quince.
2. Drupe Fruits.
   Apricot, cherry, date, nectarine, peach, plum, persimmon.
3. Citrus Fruits.
   Citron, grape fruit (shaddock or pomelo), kumquat, lemon, lime, mandarin, orange, tangarine.

B. *Vine Fruits.*

1. Grape.

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[1] U. S. Dept. Agri., Farmers' Bull. No. 293.

[2] Cyclopedia of Am. Horticulture, L. H. Bailey (in part).

Small Fruits.

1. Blackberry, blueberry (cloudberry), barberry, cranberry, currant (red and white), currant (black), dewberry, elderberry, gooseberry, huckleberry (whortleberry, bilberry), loganberry, mulberry, raspberry (red and white), raspberry (black, blackcap), serviceberry, squawberry, strawberry.

this list may be conveniently added:

Miscellaneous Fruits.

1. Agave, avocado (alligator pear), banana (plantain), bread fruit, fig, guava, mango, olive, papaw, pomegranate, prickly pear, pineapple, cashew fruit.

Garden Fruits.

1. Citron, cucumber, egg-plant (aubergine), vegetable marrow, melon (cantaloup, muskmelon), watermelon, pumpkin, squash, tomato.

Composition

during the ripening and maturing process. The per cent. of the different sugars and of the acid in common fruits is as follows:[1]

	Cane sugar	Reducing sugar	Acid
Apricots	6.04	2.74	1.864
Pineapples	11.33	1.98	0.547
English cherries	0.00	10.00	0.661
Lemons	0.41	1.06	4.706
Figs	0.00	11.55	0.057
Strawberries	6.33	4.98	0.550
Raspberries	2.01	5.22	1.380
Gooseberries	0.00	6.40	1.574
Oranges	4.22	4.36	0.448
Peaches (green)	0.92	1.07	3.900
Pears (madeleine)	0.36	8.42	0.115
Apples	2.19	5.45	0.633
Prunes	5.24	2.43	1.288
Grapes (hothouse)	0.00	17.26	0.345
Grapes (green)	0.00	1.60	2.485
Apples	5.28	8.72	1.148

The changes that take place in the process of ripening are admirably shown in a series of Analyses of Baldwin Apples made by the Pennsylvania Department of Agriculture, and published in their bulletin No. 58. Samples of "very green," "green," "ripe" and "overripe" apples were taken, and analyzed with the following results in the order mentioned: Invert sugar 6.40, 6.46, 7.70, 8.81; sucrose 1.63, 4.05, 6.81, 5.26; total sugar by addition 8.03, 10.51, 14.51, 14.07; starch 4.14; 3.67, 0.17, blank. The free malic acid in the "very green" apples was 1.14 per cent. and in the overripe apples only 0.48 per cent.

Vegetable Acids

In the entire range of foods, it is only in fruits that the vegetable acids are in sufficient abundance to be of importance. They also add much to the flavor of fruits.

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[1] Ann. Chem. Phys., 59, p. 233. See also Food Inspec. and Analysis, Leach, 4th Ed., p. 587.

ly a small number of *organic acids* are found in fruits.[1] are malic acid ($H_2C_4H_4O_5$), which occurs especially in , pears, currants, berries, pineapples, grapes and cherries; acid ($H_3C_6H_5O_7$), which is found most abundantly in the of limes, lemons, oranges, currants, unripe tomatoes and erries; and tartaric acid ($H_2C_4H_4O_6$) which is the character- cid of grapes. In the latter fruit the acid occurs as acid ium tartrate ($KHC_4H_4O_6$), the well-known basis of the n of tartar" of commerce. (See p. 264.) Racemic acid, a of tartaric acid, is found in smaller quantities in some fruits, lly in grapes. Acetic acid is not a normal constituent of but results from the fermentation of sugars and starches in (See Vinegar, p. 235.)

e above fruit acids are found in various proportions in fruit where they occur usually as acid salts of potassium, sodium ium, imparting an agreeable flavor to the juice, and adding lesome and stimulating variety to food. It is a question mass or jelly, especially on cooling after boiling and often by continued exposure to sunlight.

Pectin is frequently not found in the juice of *raw* fruits.[1] Experiments have shown that there is little or no pectin in the juice of *raw* apples, *raw* grapes, and none at all in the juice of *raw* quinces. In the juice extracted from these fruits by cooking, however, there is an abundance of pectin. The juice of some fruits, as currants and blackberries, even if obtained from the *raw* fruit, contains considerable pectin, but that from the cooked fruits is much richer in this material, and a clearer jelly is usually obtained.

Fruits yield this gelatinous material best by being cooked with water, but in the case of berries and very juicy fruits but little water need be added. Some juices will partially solidify without heating but it is advisable to boil the juice for a few minutes.

These bodies are found both in the juice and the "marc," or insoluble part of the fruit. By boiling with water the latter variety becomes soluble. The pectins are precipitated or thrown out of solution by such substances as alcohols, sugars, salts, etc., therefore hard water should not be used in the treatment of the raw fruit.

Pectin bodies yield reducing sugars, furfurol and mucic acid in varying quantities, by chemical treatment. We are still somewhat at a loss to determine the exact function of pectin bodies in fruits and vegetables, although it has been suggested that they are reserve material or a by-product, or perhaps a substance needed in building up the structure of the organic constituents. These pectin bodies are usually regarded as resulting from the combination of several simpler carbohydrates.[2] As they are closely related to starch and also to gum arabic, this property of gelatinizing is not surprising, as it is due to the colloid condition of the particles.[3]

[1] Univ. of Ill. Bull., Vol. 9, No. 36, 1912.
[2] U. S. Dept. Agri., Bu. Chem. Bull. No. 94.
[3] Fellenberg, Ch. Abs., Vol. 9, p. 488.

Mineral Salts

e organic acids of fruits are frequently united with potas-
sodium, calcium and other bases. Besides these the ash
the presence of small quantities of phosphates, carbonates,
s and chlorides. Some have asserted that the iron in fruit is
cial value in the food, as it may afford a convenient means
ing this element into the system. It is well known that min-
lts are positively essential for the growth and nourishment of
dy, and Bunge indeed has shown that the nitrogenous prod-
f metabolism cannot be eliminated from the body unless
l salts are present.

)RING, PRESERVING AND CANNING OF FOODS

account of their perishability many methods have been
d to keep fruits and other foods from one season to another,

Farther than this the art of the preservation of foods did not make much progress until it was understood that decay is due to the growth of low orders of microörganisms as shown by the researches of Pasteur and others. Whatever process will destroy the germs of these organisms, or inhibit their growth, will preserve the food. As food products decay more rapidly in the presence of moisture the foods are dried; as the germs grow better at a moderately high temperature, cold storage is adopted. The temperature of boiling water kills most of the organisms, and therefore sterilization and subsequent sealing to keep apart from a germ-laden atmosphere has become a widely accepted process. It is also proven that the organisms do not flourish in the presence of alcohol, sugar, vinegar, salts, spices or the substances that are present in wood smoke.

In highly nitrogenous foods like meat, game and fish, bacteria may readily grow,[1] while the carbonaceous products like fruits and vegetables are especially liable to be the breeding place of yeasts and molds.

PRESERVATION OF FRUIT (DRYING)

In early times the favorite method for preserving fruit was by drying, as the lower organisms do not thrive except where there is at least 25 per cent. of water. A great variety of fruits including apples, pears, peaches, apricot, grapes, plums, quinces, cherries, raspberries, blackberries, and huckleberries, are still preserved in this way. Some fruits, as cherries and currants, are cooked with sugar before drying.

In drying in a current of hot air the action on the fruit is entirely different from the sun-drying process. The hot air (about 240° F.) coagulates some of the albumin, changes some of the starch to glucose, renders inactive the diastase, and destroys bacteria and other organisms. The current of hot air that ascends through the drier carries so much steam that the temperature is considerably lowered during its passage.

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[1] See under Preservative of Meats, etc.

/hen dried by the old-fashioned domestic methods, apples other fruits were exposed to dust, dirt, bacteria and flies r conditions that were decidedly unsanitary. To-day, the cially "evaporated" fruits command a much better price the domestic sun-dried product, although sun-dried fruit is very important product of California. Commercial evapos did not come into general use in the United States until t 1870.

the great fruit-growing states like California, New York Michigan, the fruit-evaporating establishments are built on ge scale and handle great quantities of fruit, but portable driers can be easily constructed and are perfectly practicable for use on the kitchen stove, or a special furnace.

Fruit Evaporators

n evaporator may be so constructed that heated air circulates with an endless chain device on which the racks containing the drying fruit are placed. The fresh fruit is charged on the first floor, and the whole series of racks is gradually lifted as new racks are filled. As the trays are removed on the second floor, it is evident that the fresh fruit is exposed to the highest temperature, and the steam passes up over the more completely dried fruit. Some believe that a system in which the order of exposure to heat is reversed, so that the driest fruit would be exposed to the greatest heat is more satisfactory. A tower having a capacity of twenty-five trays, each 49×49 inches, will evaporate about 50 bushels of apples per day.

A **cold air** evaporator, in which the moisture of the fruit is carried off by a blast of cold air is in use. Calcium chloride is set around the chamber to absorb the moisture. In the *vacuum* process the hot air is let into the chamber and pumped off several times, thus drying the fruit very rapidly.

In most evaporating establishments the fruit is exposed to fumes of burning sulfur, or sulfur dioxide gas (SO_2) before being dried. This is for the double object of bleaching the fruit, that has become discolored by contact with air after slicing and to destroy living organisms. A limited amount of this sulfuring might be allowed, but there is a tendency to use too much sulfur dioxide, and also to use it in "reprocessing" fruit that is wormy and of low grade, to make it appear better and hence more salable.

It is stated on good authority that while sulfur dioxide is necessary in the preparation of fruit dried in the sun, it need not be used if the fruit is dried by artificial heat. At the present time the United States' standards (F. I. D. No. 76) limit the amount of sulfur dioxide to 350 milligrams per kilo, with an allowance of not over 20 per cent. of this in a free state. The fact of the presence of sulfur dioxide in the product should be stated on the label. In Prussia and Saxony the maximum amount of sulfur dioxide allowed is 0.125 per cent.

There is an enormous increase in the amount of dried fruit produced in the United States, within the past ten years. At t the output is more than 500,000,000 pounds annually, of California produces about 80 per cent.

Preservation with Sugar

a strong *solution of sugar*, honey or glucose, will prevent the
ı of the molds or yeasts, with which the air is usually laden,
ore, a process of sterilizing in sugar syrup has been used,
he time when sugar came into general use. In this process
of the cane sugar, which is present in some fruits (see p. 210)
verted" by heating with the acid in the fruit, as is also some
added cane sugar. This invert or fruit sugar, although not
et as cane sugar, is believed to be fully as wholesome as the
and probably more easily digested. For preserves, three-
s of a pound or sometimes as much as a pound of sugar is
or each pound of fruit, but the amount needed varies for
nt fruits. The fruit need not of course be kept in air-tight
nless in a hot climate, but it is better to protect the surface
uring over it melted paraffin. *Candied fruits* contain more

by the use of a wooden "masher." Sugar is then added and the mass is boiled for about ten minutes more.

Adulteration of Jams, Jellies and Preserves

Jams, jellies and preserves are sometimes adulterated by supplying the deficiency in pectose bodies by the addition of some foreign substance to gelatinize and thus improve the appearance of the product. "Agar-agar," gelatin, turnips, vegetable marrow, boiled sago, and similar substances have been used. The use of apple pulp or gooseberry pulp, both of which are rich in pectin, is not so serious an adulteration, as it is only replacing one fruit juice by another. In this case, however, the substitution should be plainly indicated on the package. It is quite a common practice to dry the parings, cores and trimmings from apples, during the drying season, and to soak this product with water in winter and use this solution as a basis for pectin.

If glucose is used its presence should also be stated. Glucose is, of course, wholesome enough, but it has not the sweetening power of cane sugar and is a substitution of a cheap food for a more expensive article. The use of saccharin, once common in the United States, in this class of goods, is now forbidden.

There is no necessity for adding any preservative other than sugar, if care is exercised in the selection of the fruit that is used, and in the process of preserving. Sodium sulfite and sodium benzoate are the preservatives that have come into most general use. There is danger that carelessness in manufacture or bad stock be more or less covered up by the use of chemical preservatives.

Another adulteration is the addition of coloring matter, very often an anilin color, to correct any deficit from lack of genuine ripe fruit. In fact the commercial jams that were upon the market in the United States, before the passage of the so-called "pure food" laws, were very often entirely artificial, and contained

is of fruit jellies, especially by large manufacturers, and the
d flavor is obtained by the use of some other fruit juice,
in itself is lacking in jelly-making qualities. This apple
is now on the market, for household use.

housewife has learned by experience that partially ripe
re often much more suitable for jelly making than those
e fully ripe, and the juice of a ripe fruit may be mixed with
another fruit which is partially ripe, as for instance green
erries or currants may be mixed with ripe raspberries or
erries to give excellent results. In domestic practice it has
und that small lots of 1 or 2 quarts of juice can be more sat-
rily worked than larger quantities. When cool the jelly
covered with netting and placed in the sun for a while to
te the process of gelatinizing. When thoroughly set
he jelly with melted paraffin to protect from the germ-laden
here, and close the glasses with tight tin covers, to pro-
m insects and mice.

are often prescribed for dyspepsia, and diseases of the liver and kidneys. Fruit syrups differ from fruit juices in containing more sugar.

Fruit vinegars are similar to the fruit juices, and are used to make slightly acid beverages. They are made, usually from berries, by soaking them with vinegar, straining and extracting several times and boiling for a few minutes. They should be preserved in sterilized bottles.

COLD STORAGE

Cold storage has been used very successfully upon fruits as well as upon meats, fish, game, eggs and butter. It should not be forgotten that the life processes go on, although slowly, in fruit, even at a low temperature. The fungi, and bacteria are always ready to produce decay, and their action is only *retarded* by the low temperature. The condition of the fruit when put into cold storage, its ripeness, its soundness and freedom from bruises, all affect its keeping qualities.[1]

During the process of ripening of fruits, which of course takes place to some extent even at low temperature, carbon dioxide gas is given off, and there is usually a tendency for the fruit to increase in temperature. The amount of carbon dioxide evolved is directly reduced by a low temperature, showing that the ripening of the fruit is thus retarded.[2] The fruit also loses moisture.

By cold storage fruits may be "held over" several months without decaying, and the season during which they can be used may thus be extended. The modern cold storage warehouse has its ice plant so arranged that cold brine can be circulated in pipes through the rooms in which the fruit is stored. Sometimes, also, the liquid ammonia used for refrigeration is allowed to expand directly in the pipes in the refrigerating rooms, or air previously cooled is circulated through the warehouse. The temperature may thus be reduced to 32° F. or even below and can be acely controlled. It has been ascertained, however, that for varieties of apples a lower temperature is required than for s, and in fact there is a special temperature which has been l most satisfactory for keeping each kind of fruit. This is ly, however, from 31° F. to 35° F. The same principle is ved in the shipping of fruit in iced refrigerator cars, and by provided with refrigerating apparatus.

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[1] U. S. Dept. Agri. Bur. Plant Indust. Bull. No. 48.

[2] U. S. Dept. Agri., Bu. Chem. Bull. No. 142.

is the general opinion that fruits as well as other produce, have been kept in cold storage for some time, show a tendency teriorate or "go down" very quickly when removed from arehouse. Fruit stored in cellars or caves at a temperature r to that of the outside air does not deteriorate so rapidly removed to rooms kept at ordinary temperature, as does the storage product.

he principal objection that has been urged against the storage system is that it affords the opportunity, under in conditions of the market, to "corner" special products.

seem to indicate, but it was not until 1804 that M. Nicholas Appert, a Frenchman, announced that meat and other organic substances would keep for a long time if sealed in vessels and then heated for some time in boiling water. In 1810 he suggested the method of heating in steam and then sealing so that on cooling a vacuum was produced. Ten years later Daggett and Kensett of New York, introduced a modification of this process, for which they later secured a patent. Wm. Underwood & Co. introduced a similar process about the same time in Boston. The chemistry of the process was not well understood, however, until explained by Tyndall, Pasteur and others. The industry gradually grew in importance, stimulated at first by the needs of the "49"ers who crossed the plains, and later by the exigencies of the Civil War.[1]

Conditions to be Met

Yeasts grow rapidly in dilute sugar solutions if there be present enough nitrogenous matter and mineral salts to nourish them, but they do not grow well in a strong solution of pure sugar. Very acid fruits do not afford a favorable medium for the growth of bacteria and yeasts, therefore such fruits as lemons and cranberries do not as readily decay. Most organisms are destroyed by exposure for twenty minutes to a temeprature of 212° F., although there are a few bacteria and some spores that require a higher temperature, or that of boiling water for a longer time. As small fruits can be more thoroughly heated throughout than large fruits, while the temperature of 212° F. may be sufficient for the smaller fruits, the larger fruits are often heated in an "autoclave"; a closed vessel in which the temperature may be raised to 240° F. if desired. It is not necessary to use sugar in canning fruit, and many prefer to add it, when the fruit is served. It must be said however that the flavor of the fruit is usually improved if at least one-fourth its weight of sugar is used in canning. Among the vegetables, peas, beans, pumpkins, beets and sweet potatoes require a temperature in processing.[1]

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[1] Cyclop. of Am. Agri., Vol. 2.

Canning in the Household

domestic practice fruit may be canned in two ways: first, iling to fully sterilize, in a porcelain-lined kettle, and then ng the fruit directly into glass or tin cans which have just usly been sterilized with hot water, then closing as quickly ssible; or, second, the fruit may be packed raw into the either with or without sugar, cold water added until the can d within about an inch of the top, and the cans then set in a of cold water, each can being loosely protected by its cover. ater is heated to boiling and allowed to boil from fifteen to minutes, depending on the size and hardness of the fruit; ns are lifted from the kettle, filled to the top with boiling and immediately sealed. By placing a wooden rack in ottom of a wash boiler a number of cans may be processed in ray at one time. This latter method is especially adapted for

Some fruits, as green currants, green grapes, gooseberries or cranberries may be kept, by simply filling the can with cold water which has been freshly boiled, and sealing. The tough skin and the acid present in the fruit assist in this process.

Canning in the Factory

The three following methods are in use in the canning factories: Packing cold in the cans, then sterilizing; packing hot after cooking and processing after the cans are sealed; and third the vacuum process which is applicable as a rule to glass packages. By the first process the cans are filled with the fruit and then boiling water is added until the cans are nearly full. The can is sealed and then sterilized under slight pressure, by heating in a retort for six minutes at a temperature of 212°F. If the contents of the can is cooked before it is put in the can, it must be processed after the cans are sealed. In the case of tomatoes a temperature of 220° to 235° F. is necessary and this must be maintained for 20 to 30 minutes to insure complete sterilization. In the vacuum process the air is exhausted from the container in a vacuum chamber and the lids are sucked down on to the top of the can against a rubber gasket, which insures a tight joint. In the older style of can the seams were soldered and the fruit was put in through an opening in the top, the lid was soldered on and a tiny vent was made in the top which was afterwards closed with a drop of solder. In the newer style of cans, known as "sanitary cans," the seams are lock-jointed, and soldered only on the outside. The cover makes a tight joint when it is spun on in the closing machine.

It has been found[1] that the gases remaining in a tin can above the fruit consist of carbon dioxide, nitrogen and hydrogen, but never oxygen. If the fruit was strongly acid and has been canned for some time, the amount of hydrogen is relatively large. The reason why "springers" as they are called are sometimes

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[1] Eighth International Congress of Appl. Chem., Vol. 18, p. 45.

, is because the process of canning and sterilizing has been rfectly carried out.

o skin peaches the canners often treat them for forty seconds a hot solution of soda lye or sodium carbonate, and then thoroughly.

anned fruits, which have stood for some time in tin, and ially "swells," are liable to contain appreciable quantities of The presence of more than 300 milligrams of tin per kilogram ned products is not allowed.[1] The most recent improvement coating of the cans on the inside with a kind of lacquer. cans are especially suitable for those fruits and vegetables liable to attack the tin.

hemical preservatives are not generally used in the canning of , although they have been used in vegetables. It is held[2] f benzoate of soda is used in a food product, it shall not be in ities above one-tenth of 1 per cent., and the fact must be y stated on the label.[3]

hundred families in the United States, that fresh fruits make up 3.8 per cent. of the total food, and supply 2.5 per cent. of the total carbohydrates. To this must be added the dried fruits used, so that all together 4.4 per cent. of the total food material and 3.7 per cent. of total carbohydrates is from fruit. As far as digestibility is concerned 80 per cent. of the protein, 90 per cent. of the fat, and 95 per cent. of the carbohydrates are digested, thus comparing favorably with the digestibility of vegetables.

From some experiments carried on at the California Ag. Experiment Station and elsewhere in which fruit and nuts constituted the sole diet of the individuals, the conclusion was reached that it is possible to supply the necessary protein and energy from these foods, although in many cases the expense per day per capita is greater than with a mixed diet. In this case the protein was derived mostly from nuts and olives and much of the carbohydrates from the fruits.

THE USES OF FRUIT

It is not the intention to discuss here the relative value of vegetable and animal foods, or the claims of "vegetarians" and others, but it is pertinent to say that under the conditions obtaining in the United States, a liberal addition of cereals and vegetables to a fruit and nut diet would decrease the bulk of the food necessary, make possible a greater and more pleasing variety of food, and lower the cost. Fruit is good, but fruit only is bad.

It is of interest to note that in tropical countries fruits grow in much greater abundance and variety than in the north, and in the polar regions practically no fruit at all is grown. Also that the fruit is produced in the temperate zone in the warmer months of the year. These facts point to the conclusion that fruits and vegetables are naturally better adapted for use in warm climates and during the warm season, and animal products where the temperature is lower.

A judicious use of fruit is without doubt extremely beneficial,

iially if one conforms in his selection to the particular needs of
ystem. Usually fruits are somewhat laxative, although some
es, like blackberries, contain enough tannin to act as slight
ngents and have a constipating effect. Fine-seeded berries
a constipating and irritating effect, and on that account
ld be avoided. On this account the fruit juice made into a
is a much more suitable diet for invalids than the whole fruit
into jam.

he organic acids of fruits are admirably adapted to assist
tion by increasing the flow of saliva and indirectly of the
ic juice. They also increase the secretions of the liver,
reas and the mucous lining of the intestines. When taken
the blood the vegetable acids render it less alkaline by combin-
vith the alkaline salts of the serum. In fact the salts of the
nic acids are changed to alkaline carbonates. These are some
ne reasons why fruits are considered so valuable as anti-
utics and for use in general debility and anæmia. They are

stored or sold, its surface is liable to be contaminated with insects, insect larvæ, worms, or injurious bacteria. In some cases it is customary to remove the outer covering before the fruit is eaten, but in the case of berries and some other fruits, this is impossible.

The process of cooking sterilizes the fruit, and protects the consumer, especially from the bacteria on the surface, which might induce disease if taken into the system.

As there is cellulose and starch in fruits, cooking softens and modifies these and renders them better fitted to be taken into the system. (See p. 12.) Some fruits, as quinces and some varieties of pears, plums and crab apples, are so hard and unpalatable that they are always cooked before they are used.

Frequently fruits and berries are cooked without the addition of water, for they contain about 85 per cent. of water, which simply needs to be set free as "juice" in the process of cooking. In baking apples there is, of course, some loss in weight, due to evaporation, but there is no loss in nutrients, if the juice that exudes is served with the apples.

There seems to be an impression that cooked fruit is sourer than that which is raw. This may be partly due to the physical condition of the cooked fruit, which would allow it to come more intimately in contact with the nerves of sensation. Hot fruit seems to give the impression of sourness more than that which has been allowed to cool, but this may be due to the stimulation of the surfaces with which the food comes in contact. Another reason for this impression of sourness is given by Sutherst,[1] in the case of gooseberries, by the fact that the skins contain more acid than the pulp, and in the cooked portion the skins are included, while if eaten raw the skins are rejected. If cane sugar is present in the fruit, it is changed to fruit sugar (see p. 95) by prolonged cooking in the presence of a vegetable acid, and fruit sugar is not as sweet as cane sugar.

It is often said that fruit is sweeter if the sugar is added after ing than if it is cooked with the fruit, and although this is etically true, it has been shown that in the cases tested, ugh the product is slightly less sweet if the sugar is added at eginning rather than the close of the operation, the difference small to be of practical importance.[1]

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[1] Chem. News, Vol. 92, p. 163.

OVERRIPE FRUIT

s the fruit becomes overripe it changes in composition, and begins to decay. This decay is caused by fungi or molds, h obtain a start most rapidly wherever the skin is broken, e fruit is bruised. This spreads very quickly to the sound ons of the fruit, and soon spoils its agreeable odor and flavor, in the parts not yet affected by decay. As previously noticed 9) with the overripening the fruit begins to ferment; that is, ugar is changed to carbon dioxide and alcohol.

WASHING FRUIT

CHAPTER IX

ORCHARD AND VINE FRUITS

Although there are not less than one hundred and forty species of fruits known in the United States, not more than forty are grown commercially. It is remarkable to what an extent and how quickly scientific methods have within the last few years been applied to fruit growing in this country. Advanced ideas in regard to spraying, pollination, fertilizing, pruning and intensive cultivation have been very successfully put into actual practice.

ORCHARD FRUITS

APPLE

Following the classification of fruits given on p. 208, the first is the apple (Pyrus malus). This is the typical and in fact the most important of the "pome" fruits. The "core" is the ripened "carpels," as they are called, and the pulp is the thickened "receptacle" on the top of which the "calyx" is borne. Botanically the apple belongs to the Rose family, which includes also the pear, quince, medlar and loquat.

It is probable that the apple as cultivated in the United States is not a descendant of our native crabs, or wild apples, but comes from the wild crabs of Europe,[1] but important varieties of apples may no doubt at some time be developed from our native crabs. Some excellent varieties of crab apples have already been cultivated.[2] Some authorities believe that both wild and cultivated apples were found in Europe from prehistoric times,[3] while others think they were early introduced into Europe from western Asia.

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[1] Farmers' Bull. No. 113.

[2] Origin of Cultivated Plants, De Candolle.

[3] The Evolution of Our Native Fruits, Bailey, L. H.

he chemical composition of apples has already been discussed : fruits (p. 209). The agreeable flavor depends on the blending of the organic acids, with the sugar and pectin rly flavored by valerianate of amyl and other fruit ethers 1 are present. The following is given by Richards[1] as the ge composition of apples. Total solids, 13.65 per cent.; o.288; acidity expressed as sulfuric acid, 8.73; cane sugar crude fiber (cellulose), 0.96. This shows that the apple is more than flavored water, as 86.35 per cent. is water. Sugar far the most valuable and abundant nutrient present. The ic acids present are malic, gallic, and tartaric which acids und free as well as in combination.

he dietetic value of apples is regarded as great, and they to prevent scurvy and act as a laxative, especially when taken an empty stomach.[2] It is said that dyspeptics find that the of the bowels can be satisfactorily regulated by the judicious f this fruit.

"pomace" by the use of hand or horse power. This juice is then set aside in barrels and soon ferments. If greater care is taken in the selection of the fruit, and especially in storing in clean barrels, at a low temperature, the fermentation will take place much more slowly. In France[1] much greater care is taken to separate the suspended impurities from the juice, and a preliminary fermentation in open vats is given the juice before storage. It is then carefully "racked off" into clean barrels, and thus prepared it keeps well, without so soon developing acetic fermentation and going over into vinegar.

It has been found that it is easy and practical to preserve unfermented apple juice, sometimes called sweet cider, by a simple process of sterilization.[2] It is true that a method still in common use in the United States for preserving apple juice is by the use of benzoate of soda, salicylic acid or sulfites. Many objections may be urged against the use of these chemical preservatives, and it must be said that at best, as ordinarily used, they only retard[3] the process of fermentation, for this ultimately takes place, and alcohol and vinegar finally result, the same as if no preservative had been added.

In the experiment of U. S. Government referred to, it is shown that apple juice can be sterilized in wooden containers at 149° to 158° F. and thus treated it will not change in six months. It is possible before sterilizing to remove much of the insoluble material from the juice by the use of a milk separator. In every case the juice must be carefully protected from the atmosphere after sterilizing.

Cider

Cider, properly speaking, is fermented apple juice, just as wine is the fermented juice of the grape. The unfermented juice or "must" contains on an average[4] 13.39 per cent. of solids, in-

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[1] Food Inspection and Analysis, Leach, p. 549.
[2] U. S. Dept. Agri., Bu. Chem. Bull. No. 118.
[3] Kans. Univ. Quarterly, Vol. 6, p. 111.
[4] U. S. Dept. Agri., Bu. Chem. Bull. No. 88.

g 10.45 per cent. of sugar. This sugar is of two kinds:
.84 per cent. of fruit or reducing sugars and 3.48 per cent.
e sugar. The acidity, in terms of sulfuric acid, is 0.37 per
nd there is 0.05 per cent. of tannin present.

course, the larger the amount of sugar in the juice, the
will be the per cent. of alcohol formed, as under the in-
e of certain yeasts found, especially on the outside of the
notably the *saccharomyces apiculatus*, sugar is changed to
l and carbon dioxide gas.

e cider[1] thus made contains from 2 to 3 per cent. of solids,
about 0.5 per cent. of invert sugar, 0.30 per cent. of malic
d a little acetic acid, with from 3 to 6 per cent. by volume
hol. If there is over 8 per cent. of alcohol present it is
t that the cider has been "fortified" by the addition
e fermentable sugar so as to raise the alcoholic percentage.
' cider is that which is produced by the complete fermenta-
the sugars.

VINEGAR

Vinegar as defined under the official standards of the Dept. Agric. is the same as cider vinegar, or apple vinegar. It is the product made by the alcoholic and subsequently acetous fermentation of the juice of the apple, is lævo-rotatory and contains not less than 4 grams of acetic acid (CH_3COOH) in 100 cubic centimeters at 20° C.

This fermentation from alcohol to vinegar is brought about by the organism known as *mycoderma aceti*, and may be induced, under proper conditions, in weak alcoholic solutions from any source. Besides cider vinegar there is found on the market wine or grape vinegar, glucose vinegar, malt vinegar and spirit, distilled or grain vinegar. Wood vinegar or acetic acid, which is made by the destructive distillation of wood, is not allowed for use in any food products in the United States. The special vinegars named are considered in connection with the discussion of their several sources.

Vinegar Making

In making cider vinegar the older process is to allow the cider to ferment in the cellar in barrels with open bungholes; a process sometimes requiring two or three years. Air must freely come in contact with the cider to bring about the change. The addition of old vinegar or "mother of vinegar" accelerates this process.

The quick or "generator" process has been largely introduced for making cider vinegar, although it was originally used for making vinegar from malt, beer and spirits. By this process, which requires only two or three days for completion, the dilute alcoholic liquor (cider) is allowed to trickle slowly over beechwood shavings which are contained in a large cask provided with a perforated bottom. (Fig. 39.) The shavings are previously saturated with old vinegar, thus insuring a thorough exposure of the liquid to the vinegar "plant." The same liquid may be pumped up and allowed to flow several times over the shavings until the alcohol is completely changed to acetic acid.

is is really a process of oxidation, and air circulates upward he shavings, thus changing the alcohol, under the influence ferment, to acetic acid. There is a notable rise in tempera- uring the process on account of the chemical action which place. The reaction is represented by the equation:

$$C_2H_5OH+O_2=CH_3COOH+H_2O$$

e vinegar plant only grows in the presence of albuminous substances and certain mineral salts, especially alkaline phosphates. The alcoholic solution should be of 3 or 4 per cent. strength to secure the best results. Too strong an alcohol prevents the action of the ferment.

The adulterations of vinegar are numerous, and vary in different vinegar made from the pomace soaked with water is also sometimes reinforced by the addition of spirit vinegar and sophisticated with apple solids. (See also p. 124.)

LOQUAT (Eriobotrya japonica)

The loquat a valuable fruit of the Rose family which originated in eastern Asia, is grown in subtropical countries, and has been introduced into California with great success. It is a small tree, which begins to bear early and is very prolific. The fruit is usually larger than the plum, yellowish or red, and grows in small bunches. The fleshy pulp, surrounds a few rather large seeds of an irregular shape, and has a sub-acid taste which is rather agreeable. As there is a large amount of pectin in this fruit and considerable acid it has come into extensive use for making loquat jelly, which is reddish in color and of fine flavor.

MEDLAR (Pyrus germanica)

Medlars are common throughout Europe and the British Isles, but not in the United States. In appearance they are somewhat like small apples and are not edible until they have undergone a peculiar ripening process, induced by the enzymes in the fruit including diastase. This process although suggestive of decay is said to be distinct from it.[1]

PEARS (Pyrus communis)

Pears also belongs botanically to the Rose family. It is probable that the cultivated pear is derived from the wild fruit that is found all over western Asia and Europe. A great variety of pears have been developed both in Europe and America. They do not differ essentially in chemical composition from apples. Some pears like the Kieffer which are hard and tasteless when gathered, ripen in storage, and after several weeks are soft and juicy. Some varieties like the Bartlett and the Sickle are of l value for canning. On account of the hard insoluble les found in some pears, they are not as digestible as apples, ally for invalids.

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[1] Food, A. H. Church.

Perry

strong fermented beverage called perry similar to cider and ning about the same per cent. of alcohol is made from pears. ne parts of the Continent pears are especially grown for this se, and the beverage is substituted for "champagne cider."

QUINCES (Cydonia vulgaris)

e quince had its origin in the north of Persia[1] near the n Sea, and wild varieties still grow there. This fruit is oned by Pliny and Plutarch as a preventive from evil ces, so it was well known even in ancient times. The has not been very much modified by cultivation, and is

APRICOT (Prunus armeniaca)

The apricot probably came originally from Armenia and is said still to be found wild in the neighborhood of the Caucasus Mountains. It grows readily in warm and temperate climates and ripens earlier than the peach, to which it is closely related. The apricot is extensively grown in China and Japan, in the oases of Africa, in Syria and more recently in California. In the latter state apricots are grown in immense quantities for shipping, canning and drying. Dried apricots contain 30 per cent. of sugars and 2.5 per cent. of free acid. There is also to be quite a market for apricot seeds for use in making "almond paste."

A product known as "*Syrian Apricot Paste*" is extensively used abroad. It is made in a basin, 2 to 3 feet deep, lined with cement. Into this the apricots, after being stoned, are thrown, and mashed or trodden with the feet. The mass is then taken out, spread quite thin on boards and dried in the sun. About 4000 tons is thus produced annually. Some of this is exported to use by manufacturers in making a "jam with apricot flavor." The paste is used in Syria as a substitute for candy; it is also made into a syrup, and is the chief ingredient of many iced drinks.[1]

CHERRY (Prunus cerasus)

The cherry has been improved from the wild cherry of Asia while another variety seems to have originated in the vicinity of the Caspian Sea. It is said that when Lucullus returned to Rome after his victory over Mithridates in the province of Pontus, that he brought with him to adorn his triumph a cherry tree, laden with fruit.[2]

Cherry trees begin to bear when four or five years old, and continue to bear to a great age, sometimes one hundred years or more. The composition of the fruit varies greatly with the variety, and the flavor is influenced by the soil and climate, as case with apples. Cherries contain on the average 20 per of solids or considerable more than apples, and there is t 11 per cent. of sugar, and 0.43 per cent. acid, expressed uric, although in reality mostly malic.

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[1] Daily Con. and Trade Rep., 1912, p. 1210.

[2] Food Products of the World M. E. Green, p. 229.

re than two hundred and fifty varieties of cherries are , some sweet and some sour. In New England, New York, gan, Iowa, and especially more recently in California, s are extensively grown for market through May, June and Some varieties, like the black and white Oxhearts, Tarta- nd Bigarreau are admirably adapted for eating, while the herries like the Morello and Early Richmond are better d for making sauces, pies and puddings. For the latter e the pit of the cherry is generally removed.

erries are a favorite fruit for canning either with or without ts. The pits are very effectively removed by machinery: gh they contain an edible oil, it has not yet been found al to separate it on a commercial scale. As cherries tend to distillation of fermented cherry juice. A very popular alcoholic liquor, especially among the Germans, is "*Kirschwasser*," which is made by the distillation of fermented cherries. It has the taste and odor of cherry pits, and contains about 50 per cent. of alcohol. ***Ratafia*** is a similar spirituous liquor, and ***Maraschino*** is a highly valued liqueur made in Dalmatia from a wild black cherry fermented with honey.

DATE (Phœnix dactylifera)

The fruit of the date palm has been from the earliest times the main dependence of the inhabitants of numerous tropical, arid lands for fruit and sugar. We know that it was grown from the Euphrates to the Nile even before the Christian era, and its cultivation is still largely confined to countries where the climate is similar to that of western Asia and northern Africa.

The Persian Gulf region is at present the center of the date-growing industry of the world. Over 5000 tons of dates have been shipped in a single year from one of the Persian gulf ports, and there are no doubt 20,000,000 date palms in this territory.

The trees may be propagated by seeds or cuttings, but the latter method gives more uniform varieties and is therefore preferred. Irrigation is practised in most of the date-growing regions. The climate is excessively hot, the temperature often remaining at 110° F. for many days and nights.[1] In Africa and the East the dates ripen at the end of August, while in Spain and Sicily they do not ripen until December. (Fig. 40.)

The trees frequently live and continue bearing for two hundred years. The soil where the palms are grown is usually alkaline, for this plant will tolerate more salt in the soil than almost any other. The pistillate and staminate (male and female) flowers are borne on different trees so when the trees are in blossom, the natives climb the pistillate trees and sprinkle the blossoms with the pollen from the staminate trees. The fruit grows in bunches of 20 pounds or more.

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[1] U. S. Dept. Agri., Bu. Plant Ind. Bull. No. 54.

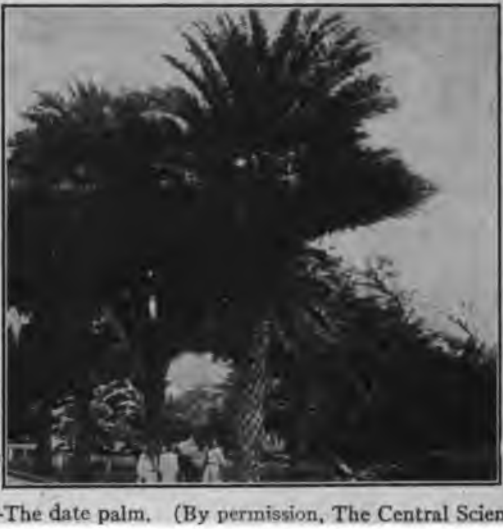

FIG. 40.—The date palm. (By permission, The Central Scientific Co.)

To prepare the dates for shipping they must be dried in the sun, as in the preparation of raisins. As some varieties are very sticky, there is every opportunity for filth from the hands and clothing of the Arabs and other natives who gather and prepare the fruit to become attached to the product, and on this account it is suggested that dates be well washed before they are eaten.

Dates can hardly be compared with ordinary fruits as they are so nutritious and constitute so large a part of the staple food of the natives of these arid regions where they are grown. It is said that half a pound of dates and a half pint of milk will make a sufficient meal for a person of sedentary habits. Dates are often pounded and pressed into cakes, and thus prepared constitute the staple "travellers' food" in these desert regions. They are soaked with water before use, thus softening the cakes and affording a pleasant beverage.

Dried dates, without the stones, as they are prepared for export, contain about 7 per cent. of proteins, 54 per cent. of sugar and 11 per cent. of pectose and gum. Although it has been claimed that an excess of sugar in the diet is injurious, it must be admitted that the Arabs of the desert are among the finest specimens of humanity, with strong bodies and very perfect teeth. Their diet of dates is in some sections supplemented with dried fish or milk, and occasionally a feast of fresh meat. The nomadic habits of these people, and the fact that they live so much of the time in the open air no doubt contribute quite largely to their splendid health.

Dates mature readily in the Imperial Valley, in the extreme southern part of California, and in Arizona.

From the sap of the date palm the Hindoos obtain "jaggery sugar," and palm wine. The latter is made into a spirituous liqueur called "toddy," and also into vinegar. (See p. 116.)

PEACH (Amygdalus persica)

There has been much research devoted to the question of the origin of the peach, and although many have believed that it came first from Persia, there is considerable evidence to show that s originally grown in China.[1] It is cultivated extensively e semi-tropical regions of Europe, Africa and Asia, and in localities throughout the United States.

he peach is readily propagated by its seeds, but the trees grown do not produce fruit that can be at all depended upon uality, so the common method of growing is by "budding" e native stock.

he peach, when fully ripe, normally contains about 88 per of water, 10.8 per cent. of sugar and other carbohydrates, .7 per cent. of proteins. The flesh of the peach is flavored by resence of a small quantity of hydrocyanic acid, and fruit s. In general there are two kinds of peaches, free stones in the pulp separates readily from the stone, and "clings" ich the pulp adheres tenaciously to the stone.

s peaches ripen[2] the reducing sugars decrease in quantity sucrose increases; the amount of acid also decreases. It

The areas in the United States where the peach can be successfully grown are much scattered, as the tree and the fruit are both susceptible to changes of temperature. Peaches are liable to be killed if there is high temperature early in the spring followed by a drop to freezing. It has been found that proximity to large bodies of water so ameliorates the climate that peaches can be successfully grown in those parts of the country that would otherwise be too far north. On this account peaches are grown on the south side of the Great Lakes in New York and Ohio, on the east shore of Lake Michigan, also in the vicinity of the salt water from Connecticut to the Chesapeake peninsula and in Georgia. Another peach-growing area is southern Illinois, Missouri, and Kansas.

The *nectarine* is often classed as a special variety of peach, or a "sport." It has a smooth skin and characteristic flavor.

Peach cider is made from the fermented juice of the inferior peaches, and when this fermented juice is distilled the product is known as peach brandy, an alcoholic liquor containing about 50 per cent. of absolute alcohol.

PLUM (Prunus domestica)

The plum which is grown in Europe and America is probably a native of Asia, but was brought to Europe hundreds of years ago, and subsequently to America. In addition to the Prunus domestica, there are many varieties of plums which have their origin from wild species found in other countries. Among these may be mentioned the cherry-plum types which are noticed in southeastern Europe; the Japanese or Chinese plums; the American type as the wild goose plum, sand plum, etc. Among the domesticated varieties especially prized are the Damsons, originally introduced from Damascus, Green Gages and Mirabelles.

Plums are grown in the same way as peaches, and as there is a greater variety, they probably have a wider region of cultivation. They are rich in sugar—the average of three samples

plums showed 13.25 per cent. of sugar and 21.6 per
solids. Some varieties contain a large quantity of
stances. Plum butter is a favorite form of plum
Since plums contain so much sugar it would be
ey had not been used for making alcohol. That this
is shown by the common use in Roumania of a mild
"tsuica," which is distilled from Damson plums, and
s a similar product made in Hungary from plums and

oe or Blackthorn is a plant of the plum family, which
ur, astringent fruit which is utilized in Europe for pre-
nd for flavoring various liquors.

Prunes

characteristic of plums is that some varieties may be
dried to form what are known on the market as "prunes."
to make a good prune must contain a large proportion of
especially sugar, and must be adapted to drying without
moval of the pit. Formerly most of the prunes were pro-
in France, Bosnia and Servia, but now the first rank must
California,[1] where in 1918 the crop of prunes was
This industry has grown up

from five to twelve days are required to dry the prune, and in the evaporator from twelve to forty-eight hours. Before cooking, prunes should be thoroughly washed, soaked in cold water for twelve hours, and then cooked for some time at a moderate temperature.

A form of adulteration practised especially on light colored prunes is to treat them with sulfur fumes. While this acts as a bleach, and improves the appearance, the process should be discouraged as unnecessary and making the fruit unwholesome.

Investigations have been made by the United States Department of Agriculture[1] on the commercial value of the kernels of the peach, apricot and prune. These kernels are quite similar to those of the bitter and sweet almond. From all of these, a fixed oil may be obtained and also a volatile oil. Much of the so-called almond oil on the market is really apricot-kernel oil. The volatile oil of the peach and apricot may readily take the place of bitter almond oil for many purposes.

PERSIMMON (Diospyros virginiana)

The persimmon or "kaki" came originally from Japan and China, and also grows wild in the central and southern part of the United States, and in Mexico. (Fig. 42.) This fruit has only recently received special attention in the United States,[2] although it has for a long time been cultivated in Japan where it has been greatly improved so that now it is from 2 to 3 inches in diameter. The natural fruit is reddish yellow, about the size of a large plum and contains from four to eight seeds. The Japanese Persimmon (Diospyros Kaki) is now grown in the United States in some localities.

There has been more or less prejudice against the persimmon on account of its astringent or "puckery" taste when not fully ripened. The common opinion is that it must be exposed to the frost before being fit to eat, but this is simply accidental and many ies ripen fully before the frost comes. The astringency of ersimmon is due to the presence of tannin, a vegetable acid, unripe fruit, and this is probably changed to sugar in the ing process.

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[1] Bu. of Plant Industry, Bull. No. 133.

[2] U. S. Dept. Agri., Bu. Chem. Bull. No. 141

had been learned[1] that the Japanese ripen persimmons ially by placing them from eight to fifteen days in casks which the native beer, called "saké," has been emptied. A mps of starch are placed in the cask to absorb the excess of ure. Studies on this process revealed the fact that this arti-

containing but few seeds, can be produced from the native American persimmon. They may be used for making pies, sauce, puddings, etc. Persimmons dried like figs are exported from China and Japan.

CITRUS FRUITS

The class of citrus fruits include a number of botanical species, such as the orange, mandarin, grape fruit (pomelo or shaddock) kumquat, citron, lemon and lime. These fruits came originally from China, and other parts of Asia, but were very early introduced into the regions bordering on the Mediterranean Sea, and subsequently into the Western Continent. They may be grown anywhere, where there is sufficient moisture and where the temperature does not fall below 18° F. nor rise above 100° F.[1] The ideal region for their growth is where the winter temperature is not below 26° F., except for a very few hours. The flavor of the fruit is finer if it is grown in the coldest climate where the trees will flourish. In excessively dry regions, if the soil is fertile, citrus fruits are grown with the aid of irrigation.

These fruits are all characterized by a thick peel or rind which is not usually edible, but is utilized for the production of the volatile oil, which is present in abundance. As much as one-fourth of the weight of the fruit is often removed with the peel. The principal acid of these fruits is citric ($C_6H_8O_7+H_2O$). Phosphoric (H_3PO_4) and a little malic acid, are also present and the sugar, which is both cane and invert, varies within a wide range from less than 1 to over 10 per cent.

CITRON

The *citron* (Citrus medica, var. acida) is cultivated extensively in China, Persia, the Mediterranean countries and California. It has been suggested that most of the other citrus fruits have been produced by culture from the wild citron. The tree is similar

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[1] U. S. Dept. Agri., Farmers' Bull. No. 238.

emon, and bears flowers that are purple without and white The fruit is oblong, protrudent at the tip, from 5 to 6 long, greenish yellow in color, and very fragrant. The consists of a somewhat acid pulp from which a juice is ed, which is used like lime juice. The rind of the citron, is thick and spongy, is much used in the preparation of l or preserved citron. This confection, which contains from 3 per cent. of sugar, is extensively shipped from Mediter- ports. This citron should be carefully distinguished from r fruit of the same name, grown in the United States, s really a variety of watermelon, and the pulp of which is ed to make a candied confection.

GRAPE FRUIT

pomelo (Citrus decumana) or *grape fruit*, the largest of its of this family, which came originally from China, is a yellow, growing in clusters, and only about 1 to 1 1/2 inches in diameter. The thin rind is sweet and aromatic, and the entire fruit—rind and all—is usually eaten. The tree is exceedingly ornamental when covered with its green leaves and bright yellow fruit.

LEMON

The lemon (Citrus limonum) was introduced originally from eastern Asia, but very early became an important fruit on the shores of the Mediterranean Sea, as this climate was found to be well adapted to its cultivation. Like the orange it grows in subtropical countries where it has an abundance of moisture and a fertile soil. The fruit is gathered, even though still green, when it has reached a marketable size, for if allowed to ripen on the tree it is coarse and of poor quality.[1] The unripe fruit is carefully cured, a process that often requires from 2 to 4 months. It may be kept best in cold storage, at a temperature of about 40° F., unimpaired from 8 to 12 weeks.

The lemon contains less than one-half of 1 per cent. of sugar, and over 5 per cent. of citric acid. It is especially characterized by its essential oil, which is found in the rather heavy rind.

The acids in the lemon occur both free and combined with a base, usually potassium. On account of its composition, high acidity and low sugar content, and because the tough rind protects the fruit so that it will bear transportation and storage, the lemon is used the world over for flavoring, as a relish and for making acid beverages.

"Lemonade," "citronade," or "lemon squash," is a cool refreshing beverage especially suitable for the use of people of a bilious temperament. The alkaline citrates of the juice enter the blood, and are partly oxidized in the system to carbon dioxide and water, and partly changed to carbonates. Lemonade should be made by rolling the lemon, expressing the juice, and mixing this with the peel cut in slices, a sufficient quantity of water and sugar,

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[1] Grocer's Encyclopedia, p. 331.

ng else should be used. There is some fictitious lemon-
e market, which is acidified with tartaric or phosphoric
ored with extract of lemon, and even colored with anilin

enter of the lemon industry is southern Italy and Sicily,
he climate is much like that of Florida and southern
ia. In Sicily[1] particularly, lemons are grown in great
nce. One variety grown there is the Verdelli, and in its
ion the trees are kept without water from April to July,
hey are heavily watered, so that this fruit does not mature
Iay. Before the disastrous earthquake of 1908, Messina
e center of the trade in lemon oil and in the citrate products.
s estimated that the crop of lemons in 1907 in Sicily and
ria amounted to 6,900,000,000 lemons. About one-third of
op is used for citric acid, citrate of lime, lemon oil and candied
n peel.

Oil of Lemon

the “culls” or small

skilled workman, and for this labor he receives from 40 to 60 cents. When considerable oil has been obtained on the surface of the liquid, it is blown over the edge of the bowl into another receptacle.

By the machine method of manufacture, which is only used in the province of Calabria, in Italy, the oil is pressed out of the fruit by the use of an extremely crude hand press. The product is more highly colored than that produced by the sponge method, and is used for bringing up the color of pale oils.

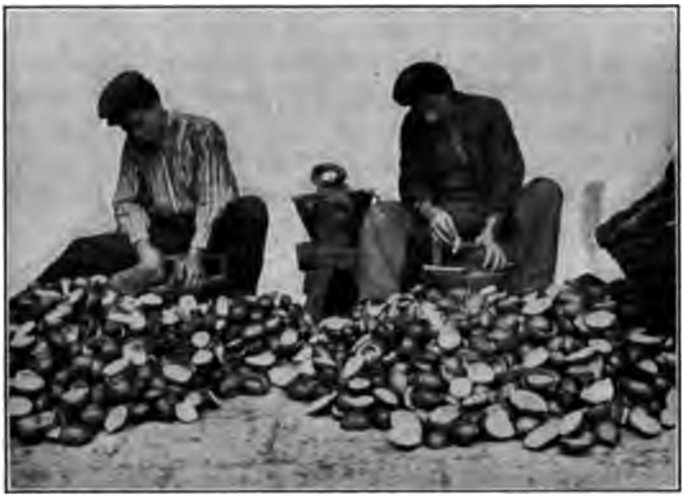

FIG. 43.—Expressing Lemon Oil. Two-piece method, as practiced at Mexicali. (By permission, U. S. Dept. Agric.)

Oil of lemon is soluble in strong (95 per cent.) alcohol, and only very slightly soluble in water. The Italian oil contains not less than 4 per cent. of a peculiar flavoring principle called citral, which is chemically speaking an aldehyde, having the composition ($C_{10}H_{16}O$). This substance is found in oil of lemon grass, and may also be made synthetically.

Lemon Extract

Genuine lemon extract is made by dissolving five parts of oil of lemon in ninety-five parts of strong alcohol. For many years

spurious than genuine extracts were on the market in the
d States. The alcohol that must be used is really more
sive than the oil of lemon, but a weak alcohol, below 45 per
will hold only a trace of lemon oil in solution. To give the
t the appearance of genuineness, sometimes it is colored yel-
ith coal tar dye.

low grade of extract of lemon[2] is made by washing lemon
th dilute alcohol, whereby the citral, the principal flavor-
aterial, is removed, and the terpenes which constitute about
cent. of the oil remain. This dilute alcoholic solution is
sis of the so-called "terpeneless" extract of lemon. It is
hat a little of the lemon flavor is given up when lemon oil is
edly shaken up with dilute alcohol, but the extracts so
are frequently worthless for baking purposes. Sometimes
extracts are flavored with "citronella" and strengthened
emon-grass citral. The standard of the U. S. Dept. of Agric.

most prized on account of this acid, the essential oil and the lime juice which may be obtained from it. Lime juice is used in medicine, and is valuable to prevent scurvy in those who are for long periods deprived of fresh vegetables. Lime juice is often adulterated with other acids, and is preserved with artificial preservatives such as salicylic acid instead of by the natural method of sterilizainto. The oil or "essence of bergamot" is made from a variety of limes which grows in the province of Calabria in southern Italy.

ORANGE

The orange (Citrus aurantium) is grown on rather small evergreen trees, and very commonly the trees bear continuously so that both blossoms and ripe fruit are seen at the same time. The thick rind of the orange is admirably adapted to protecting the pulp, and to allow the fruit if not too ripe when picked, to be transported long distances. Great skill is necessary to raise a profitable crop of oranges, especially in California and Florida, as conditions of stock, soil, climate, exposure and time of marketing, must all be carefully observed. The trees may be grown from the seed or from cuttings, but the usual method, which insures a much more uniform quality, is by budding on seedling stock.

Oranges contain from 5 to 10 per cent. of sugar, a part of which is sucrose, and a part invert sugar. The amount of acid, reckoned as citric acid, is from 1 to 2 per cent. and the amount of protein is very small. As the pulp contains about 85 per cent. of water, the nutritive value of the orange is not very high, it is however valuable from a dietetic standpoint, on account of its palatability, its mineral and organic salts, and its general influence on other food in the digestive tract.

Most of the European markets are supplied with oranges from Spain, Malta, Brazil, Italy, southern Africa and Florida. The culture of oranges began to be of importance in Florida as early as 1880, and since that time has gradually increased. In 1894–95 the severe weather killed a large number of trees, but the crop has lly increased since that date. In southern California culture began to be of commercial importance about 1880. -called "orange belt" covers 1,500,000 acres in this state, tends from near the sea level to a height of 1800 feet. The ust be abundantly supplied with water by irrigation and rcial fertilizers are extensively used. Seedless or "navel" s were first introduced into the United States from Brazil n. Saunders in 1870. The *Malta or blood orange* was lly produced by grafting the orange on pomegranate stock. fruit ripens the blood-red flakes extend through the pulp equently the whole mass is red.

Oil of Orange

ough oranges are of the most value for eating raw, they utilized for making preserves, marmalade, in which some

The orchards of Florida and California furnish such large quantities of oranges annually, that the quantity imported is now quite small.

VINE FRUITS

GRAPES (Vitis)

Grape vines are found growing wild throughout the temperate and parts of the torrid zone on both hemispheres. From these the cultivated grapes have been produced. They are most profitably grown between 55° north and 40° south latitude. The fruit of the vine is mentioned in the earliest Hebrew writings, and the records of wine making in Egypt go back for five or six thousand years..

In Europe they are grown especially in the countries around the Mediterranean Sea, as in Greece, Italy, France and Spain, also in the Canary Isands, Portugal and the Rhine valley. In the United States the best localities for vine culture are western New York and northern Virginia, Missouri, Ohio, southern Michigan and California, but the grape grows well throughout the "corn belt" from ocean to ocean.

History

During colonial times and for some years after, attempts were made to grow European varieties of grapes in America, but without success.[1] Peter Legaux, a Frenchman, started a vineyard near Philadelphia in 1793. In the same year John Dufour, a Swiss, engaged in grape culture in the valley of the Ohio in Kentucky and Indiana, and a large colony of French settlers started a vine and olive colony on the Tombigbee River in Alabama in 1805. It was learned later that the cause of the repeated failures was the fact that foreign grown stock was exposed to various pests such as a tiny plant louse called "phylloxera," and to various mildews, while from native varieties hardy stock could be secured. The first of these to be successfully grown was the Alexander, an offshoot of the ordinary fox grape, *Vitis labrusca.* The Catawba

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[1] Domestication of American Grapes, Hedrick, P. Sc. Mo., Vol. 82, p. 338.

he Concord were the first of these grapes to be extensively
i in the North and the Scuppernong from the *Vitis rotundi-*
n the South. As European grapes have a higher sugar and
content than the American species, they are better adapted
ne making, excepting champagnes. They also keep longer
can be used in making raisins. American table grapes,
ver, are more refreshing and make a better unfermented
than do the European varieties.

he quality of the grape is greatly influenced by location, soil,
te and temperature. Indeed, it often happens that the fruit
i in one locality has entirely different qualities from that
i from the same variety of vine in another locality.

he vine is propagated by cuttings or slips which are easily
d. When it is old enough to bear fruit, it is "cut back" so
nly a few shoots are allowed to bear. Sometimes the vines
ained on poles, or racks. In Italy they are often supported by

Europe, the patients frequently eat from 2 to 8 pounds of grapes per day.

Grapes are utilized principally in some one of the following five ways: 1. For eating. 2. For making raisins. 3. For making grape juice. 4. For making wine. 5. For making brandy. The fruit is readily shipped, if packed in small baskets, over long distances. Attempts to pack ripe grapes in cotton and other absorbents have met with indifferent success. Some varieties of California grapes are shipped packed in cork chips, but the very best material for this purpose is redwood sawdust.

Raisins

Several special varieties of grapes have been found to be most suitable for making raisins. These are sold under different names: 1. Muscatels[1] or raisins dried on the vines, which include Malaga, Valencia and Denia muscatels. 2. Valencias or dipped raisins, which include Lexias and Denias from Valencia, Turkey raisins shipped at Smyrna, and California raisins. 3. Sultanas, the small seedless raisins from Greece, Turkey and Persia.

For making the genuine muscatels, the white grapes grown near Malaga are used. When the grapes are ripe, the stem is partially cut or twisted so as to prevent the circulation of the sap, and the fruit is allowed to hang on the vine exposed as much as possible to the sunshine, for two or three weeks. The raisins are then ready, without further treatment, to be packed in boxes for shipment.

In preparing the dipped raisins, the ripe grapes, with the stems twisted are allowed to hang for a single day to facilitate evaporation, and are then pulled and dried in the sun for one day, rinsed with water, and finally for an instant dipped in a vat of boiling potash lye flavored with rosemary and lavender, and covered with a layer of olive oil.

The grapes are dipped by the use of a wire basket with a long handle and are then taken out and exposed in racks, to the sun-with frequent turning over. The objects of this treatment shorten the time needed for drying and to sterilize the fruit. dry, the raisins are piled in heaps to "sweat," which softens in and distributes the moisture more evenly. They are eady for packing. (Fig. 44.)

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[1] Foods, p. 611, Tibbles.

in sends more raisins to this country than any other land, gh Asiatic Turkey is sending a large quantity. California are taking the place of imported stock to quite a large . Raisins are also cut open and after the seeds are removed

Grape Juice

Before the modern methods for sterilization were understood, grape juice found but little use except for medicinal and sacramental purposes. More recently, however, since the process of sterilization has been perfected, there is an immense demand for grape juice either natural or carbonated, for making a cooling, wholesome beverage. (See Circ. No. 108, U. of Calif.)

Since invisible spores of yeasts, fungi and bacteria adhere to the skins, and stems of grapes, as to other fruits,[1] some means must be devised to prevent the fermentation which these organisms would induce. There are two practical ways of doing this: The first is by the addition of chemical preservatives such as salicylic, sulfurous, boric or benzoic acid, which kill the germs or inhibit their growth. These substances are generally regarded as injurious to health, and their use should be discouraged. The other method of preventing fermentation is by heating the liquid to a sufficiently high temperature to kill the organisms. The lowest temperature that will do this effectively has been found to be from 165° F. to 176° F. At this temperature the flavor of the juice is scarcely changed; but a higher temperature would injure it.

Manufacture[2]

The process of making grape juice is as follows: The clean sound grapes are run through a crusher and stemmer and then directly into steam jacketed kettles. In these kettles are revolving cylinders which keep the crushed grapes continually stirred, while they are being heated to a temperature of 140° F. The heated contents of the kettle is then run into the hydraulic presses beneath, and from these the juice runs into another set of aluminum kettles. Here the juice is heated to 165° F., and skimmed and then run through a pasteurizer at a temperature not lower than 175° F., nor above 180° F. The "must," as it is called, is run directly

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[1] U. S. Dept. Agri., Farmers' Bull. No. 175.

[2] U. S. Dept. Agri., Bu. Plant Industry, Bull. No. 24.

he pasteurizer into sterilized 5-gallon carboys, securely
, and stored in vaults until it has settled and cleared. After-
he clear juice is siphoned off, filtered, put into bottles,
y corked, and again pasteurized at a much lower tempera-
an the previous sterilization. Grape juice or "must" pre-
n this way will keep almost indefinitely, if stored in a cool
lace.

domestic manufacture, heat the grape juice, obtained by
nvenient method, in a double boiler, always below 200° F.,
en put into a glass or enameled vessel to settle for twenty-
ours. Then carefully decant the juice, pour it through
thicknesses of flannel, and fill into clean bottles. Set
ttles into water in a large boiler, as for canning fruit (see
), and when the water begins to simmer, take out the bot-
rk securely, and seal with wax.

e composition of "Must or Grape Juice," as given by
n[1] is as follows:

tanning extract and 1600 to 2000 tons of cattle feed, are annually obtained from the grape. The oil which is extracted from the seeds by the use of benzine, is used by painters and soap manufacturers, the oil cake is ground and macerated with water to extract a tanning extract, and the residue is the cattle feed.

WINE

The making of wine dates from the earliest historical times. Even "Noah planted a vineyard and drank of the wine thereof,"[1] and this beverage was prized by the Hebrews, Greeks, Romans, and later by the Spaniards, French, Italians and Germans.

The quality of a wine is dependent not only on the variety of grapes from which it is made, but on the methods of making and storing, locality, soil, temperature and even the weather.

Wine Making

In making wine great care is exercised that the grapes should be fully ripe, and free from any that are imperfect. The juice is expressed by "treading and pressing." (Fig. 45.) The juice is run into tanks where the fermentation is induced by various yeasts and other organisms which are found associated with the fruit or on the skins. One of the most important of these is the yeast known as *saccharomyces ellipsoidens*. After the fermentation has been allowed to continue for several weeks, the liquid is drawn off from the "lees," filtered, clarified, and put in bottles or other vessels for storage in cool cellars. Here a second fermentation usually occurs, and the wine is greatly improved in flavor and "bouquet," by the formation of various fragrant esters and ethers.

In the process of fermentation the dextrose and levulose of the grape juice is broken up as follows:

$$\underset{\text{Dextrose}}{C_6H_{12}O_6} + \underset{\text{Levulose}}{C_6H_{12}O_6} = \underset{\text{Alcohol}}{4C_2H_6O} + \underset{\substack{\text{Carbon}\\\text{dioxide}}}{4CO_2}$$

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[1] Genesis IX, 20.

e potassium bitartrate ($KHC_4H_4O_2$) which is one of the
uents of the grape juice, is less soluble in alcohol than in
and as the per cent. of alcohol increases during the fer-
tion, the "argol" as it is called or crude potassium bitar-
s deposited in the bottom of the cask. This deposit when
d is the source of the "cream of tartar" and tartaric acid
market.

presence of so much alcohol. Wines containing higher percentages of alcohol are said to be "Fortified;" that is more alcohol has been added to them. If all the sugar has been used up in fermentation the wine is said to be "dry," but if some sugar still remains it is a "sweet" wine. If the wine has been inclosed in strong bottles before the sugar was all used up, the carbon dioxide is retained in the wine under pressure, and a "Champagne" or effervescent wine is the result. If the carbon dioxide has been allowed to escape, the product is known as a "still" wine.

The best known foreign wines contain from ten to twenty-three per cent. of alcohol by volume. Some of those in most common use abroad are, Claret, a mild French wine; Sherry, a wine high in alcohol which came originally from Spain; Port, also high in alcohol and named from the city of Oporto in Portugal; Hock, a light Rhine wine; Moselle, a light wine coming from the valley of the Moselle in Germany; and Chianti a light wine produced in Tuscany and northern Italy. American wines are similar to the different "types" just mentioned. The use of wine is discussed under Alcohol, p. 147.

Since the adoption of the prohibitory amendment there is a radical change in the vine industries of California and some other States. More attention is paid to the raising of grapes for shipping, and for making raisins, grape juice and similar products.

BRANDY

Brandy is a spirit distilled from wine. Frequently low grade wines are used for this purpose. The distillation is carried on in a "pot still" to which is attached a worm surrounded by cold water, for condensing the distillate. Brandy is "aged" by being stored in wooden casks for several years. In this process the product becomes colored by the wood, and various aromatic ethers and aldehydes are developed, which improve the flavor. Brandy contains about 50 per cent. of alcohol by volume.

CHAPTER X

RRIES, GARDEN AND MISCELLANEOUS FRUITS

BERRIES

rries are peculiar in consisting of a mass of seeds, sur-
ed by a pulp which is often quite watery as in the rasp-
although sometimes firm and solid as in the gooseberry.
juice is often little else than a solution of sugars, pectin,
al salts, acids and flavoring ethers, frequently highly
d. On this account the juice of berries is the most valuable
n, as the abundant seeds have no food value for man.
act as an irritant in the alimentary canal, and are a frequent

BLACKBERRY (Rubus nigrobaccus)

The blackberry is borne the second year on the shoot which springs from the roots. Cultivation has greatly improved these berries in size and appearance, but the flavor of the native fruit has sometimes been sacrificed by this process. The berries are red before they turn black on becoming fully ripe. They contain from 4 to 5 per cent. of sugar and about 1 per cent. of acid. Blackberries are much used for canning, and making jams, jelly and preserves. Artificial jams and jellies which have apple jelly as a basis and are skillfully flavored and colored and labeled "Blackberry," have been extensively manufactured.

A wine, which is especially recommended for invalids, is made by the fermentation of blackberry juice, with the addition of some sugar. Blackberry brandy may be made by the distillation of the wine. Blackberry cordial is the juice preserved with whiskey or brandy. These products are considered very valuable from a dietetic standpoint.

BARBERRY (Berberis vulgaris)

There are many species of barberry, growing all over the north temperate zone, and in the Andes of South America. It grows wild along the Atlantic coast, and is cultivated in the interior. The shrubs are often used for ornamental purposes, and the elongated, red, acid fruit is utilized for making pickles and preserves.

CLOUDBERRY (Rubus chamaemorus)

The cloudberry is a yellowish sub-acid fruit, having a taste suggesting the tamarind. It grows wild in the extreme northern countries of Europe, especially Scotland, Norway and Lapland.

CRANBERRY (Vaccinium)

The cranberry grows on vines or low bushes, some varieties near the seashore and others on uplands, in temperate climates

n Europe and America. A wild variety known as the Prei-
re is much prized in Europe for making sauce. They have
somewhat, but not very greatly improved by cultivation.
count of the abundance of the pectose bodies which it
ns the fruit is much prized for sauce and jelly. Its rich
lor no doubt adds to its value for the decoration of the
The berry contains 9.90 per cent. of carbohydrates and
er cent. of acid as malic. On account of the acid and agree-
avor it is valued for making a sauce to serve with meats and
y. It is one of the few fruits that naturally contains appre-
quantities (0.05 per cent.) of benzoic acid. Cranberries are
n canned or preserved, as they keep well, and will bear
ortation. They have been recommended for use by
ts suffering with gout and chronic rheumatism, probably
e the alkaline carbonates that are formed in the system
he organic acids stimulate the action of the kidneys. The

are used. Some of the black currants found in America are eaten, while others, which have a very aromatic flavor, are not utilized. Black currants have secured considerable favor on account of their therapeutic action.

Zante Currants (See under Grapes, p. 260)

DEWBERRY

Dewberries are similar to blackberries, and grow wild on low vines very abundantly in the United States. They possess a very delicate flavor, often much more agreeable than that of the blackberry.

ELDERBERRY (Sambucus niger)

The elderberry grows on a small shrub, and is found wild throughout the temperate zone on both sides of the Atlantic. The ripe berries are sometimes used in making pies, but a more common use is for making elderberry wine and a cordial. The juice is also used as an adulterant and coloring material for wines.

GOOSEBERRY (Ribes grossularea)

The gooseberry has been much improved by cultivation, starting with the abundant wild varieties of Europe and America, and some very large berries are now grown. Some varieties of wild berries are thickly covered with spines. The gooseberry is sometimes eaten raw when ripe, but its most common use is for making jam either alone, or mixed with other fruits. Its abundant acid and pectin, makes it especially valuable for this purpose. There is from 1 to 1.5 per cent. of acid in the ripe fruit, and 2.66 per cent. in the skins. In the process of boiling the fruit all the cane sugar is "inverted" by the acid present so it is found as invert sugar in the jam.

MULBERRY (morus nigra) (morus subra) (morus alba)

The mulberry is a fruit which is not very extensively used as food in the United States, but the tree is valuable for building

es. The excessive sweet taste of the fruit, without suf-
acid to give a tart taste, is probably the reason why it is
ed more generally. The berries of several varieties grow
medium sized trees over a large area both in the United
and Europe. The growth of mulberry trees was very
extended in the United States, by the "silkworm craze"
overran the country more than a hundred years ago. A
palatable wine is made by the fermentation of mulberry
nd in Siberia a spirit is distilled from it. The *morus alba*
as the almost exclusive food for several months by the
s.[1] The dried fruit is very palatable, almost seedless, and
unt of the large percentage of sugar which it contains, has a
lue almost as high as the fig.

RASPBERRY (red) (Rubus strigosus)

e raspberry is one of the most abundant wild fruits or in color, large and luscious, and by many considered superior to either the red Antwerp raspberry or the blackberry from which it was obtained. It is grown extensively in Oregon and Washington, and used especially for canning and the making of loganberry juice.

HUCKLEBERRY

Whortleberry, Blueberry, Bilberry (Vaccinium)

The huckleberry is found throughout the north temperate zone. There are many varieties of related shrubs growing wild, but they were until recently very seldom cultivated. These berries grow in immense quantities on waste lands in the northern United States and in Canada, where they are gathered by the natives and their sale forms an important addition to the revenue of the people. They are sufficiently hard to bear transportation to distant cities. Some varieties are large and juicy, while others (called "stoners" in the north) are hard and filled with seeds. Some blueberries grow on bushes less than a foot high, while in the swamps are often found bushes 10 feet high.

It has been found[1] that the blueberry plant has on its roots a minute fungus which has the function of furnishing nitrogenous food to the plant. An acid soil is the first essential to the successful culture of this berry. It naturally follows that much soil which has been considered worthless on account of its acidity, can be utilized for blueberry culture.

These berries contain from 76 to 89 per cent. of water, 5 per cent. of sugar, some pectin and from 1 to 1.6 per cent. of free malic and citric acid. Huckleberries may with care be dried so that they will keep during the winter, they may also be preserved by canning. Some varieties make excellent jelly, and the juice is used for making a cooling beverage. Huckleberries are specially prized for making pies and sauce.

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[1] F. V. Coville, U. S. Dept. Agric.

SERVICE BERRY (Amelanchier canadensis)

ne service berry known also as the June berry or Shad berry, ed to black berry which grows on a medium-sized tree.[1] y be recognized by its white racemes of flowers in the early , and its fruit in the early summer. The tree ranges ghout the eastern United States southward to Florida, and ard as far as Minnesota. The fruit is a great favorite with irds and squirrels, and has found some use by man either ting raw or for making into sauce. This is an entirely ent tree from the "Service Tree" (pyrus sorbus) of Italy and ern Europe.

RAWBERRY (Fragaria chiloensis, F. vesca and other F.)

ne strawberry, unlike most berries, is in reality a "re- le," which bears the "achenes" or true fruit on its surface. ws wild over a large area in Europe, Asia and America from

Since this berry needs only a short season for its growth, it can be grown very early in a warm climate and shipped to a colder climate, and late in the season a northern-grown berry can be shipped to the country farther south, so the strawberry season is extended over several months for those living in the temperate climate. One peculiarity of this fruit is, that with some persons who have a peculiar idiosyncrasy, its use produces hives or other symptoms of indigestion, so that these persons are obliged to absolutely give up the use of strawberries.

MISCELLANEOUS FRUITS

AGAVE (Agave Americana)

The agave or American aloe or Maguéy, also known as the century plant, has been cultivated for hundreds of years in Mexico and other semi-tropical countries. The sap or saccharine juice of this plant, when fermented, yields the "*pulque*" an alcoholic beverage much used in these warm countries. See p. 146.

AVOCADO (Persea gratissima)

The avocado, known also as the "alligator pear" or custard apple is readily grown in all semi-tropical countries, and is highly esteemed as a salad fruit, like the cucumber or the green olive.[1] It seems to have come originally from Mexico or South America. The fruit, which grows on a tree from 20 to 60 feet in height, is pear shaped, 4 to 6 inches long, and of a greenish or brownish color. The pulp has a buttery consistency, and is eaten with salt, vinegar and other condiments. This fruit is rich in fat (10 to 20 per cent.) and contains 6.8 per cent. of carbohydrates. Most of the avocados on the market come from Mexico, Cuba, Porto Rico and Costa Rica, but it has been recently shown that they can be readily grown in California and Florida. Although this fruit is at present sold at a high price, it is believed that when a taste for it has once been cultivated, a more extensive demand will make it cheaper and more abundant.

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[1] U. S. Dept. Agri., Bu. pl. Ind. Nos. 61 and 67. Bull. 254, Calif. Ag. Ex. Sta.

BANANA (Musa sapientum)

those who live in tropical countries the banana and the ain (Musa paradisaica), are of nearly as much importance od as are the cereals to those who live in more temperate tes. A knowledge of the banana belonged to some of the

digenous to Asia it is now cultivated not only in the Orient, southern Europe and Africa, but in many parts of Central and South America, and in the tropical islands.

The plant bearing this fruit is herbaceous, and dies or is cut down after fruitage, and new stalks spring from the roots. It is a marvel of productiveness, so that it is estimated that a greater quantity of actual food can be grown on an acre planted with bananas than if planted with wheat, potatoes or any other food-bearing plants. The tree grows to the height of from 20 to 40 feet, and the immense bunches of fruit, weighing often 100 pounds, bear from one hundred to two hundred bananas. (Fig 46.)

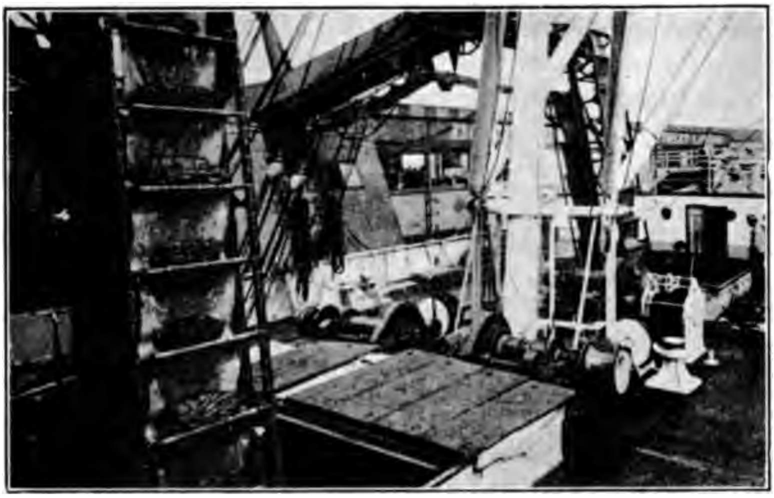

FIG. 47.—Unloading bananas from hold of steamer.

In the propagation of the tree and for starting a new plantation, seeds are not used, for the fruit practically has none, but shoots cut from the old plants, and these sprout so rapidly that they come to full maturity in ten or twelve months. There are more than one hundred and fifty varieties known, some yellow and some red, but all used for food in the countries where they grow abundantly. For local consumption the fruit is cut before it is fully

ut at a time when it is estimated that there is nutriment
in the stem to supply the bananas until they have fully
l. If the fruit is intended for shipment to some distance,
t be cut still earlier; in fact while the bananas appear to
green.

of the most important and valuable properties of this
that it ripens well after being cut from the tree, so that
bear shipment and long storage. Fruit steamers, capable
ying 40,000 bunches of bananas on a single trip, and pro-
vith facilities for cooling and ventilating, have been built
lly for the banana trade. By this means the abundant
of Central and South America and the West Indies are
t in good condition to the European and United States ports.
7).

Composition

to live on bananas alone would suffer in the same way as the person who attempts to live only on potatoes. (See p. 154.) This fruit is, however, a *food* and should be used as such in the arrangement of the diet. It is not to be classed with such fruits as apples and oranges, although often appearing for dessert on the same plate with them.

A study of the carbohydrates of the ripe and unripe banana pulp[1] shows—

	Unripe fruit	Ripe fruit
Reducing sugars before hydrolysis (as glucose)	0.08	4.21
Increase after hydrolysis (as glucose)	0.15	5.82
Dextrins, etc. (as glucose)	0.50	3.43
Starch (as such)	13.99	0.71
Xylose and other pentoses (as glucose)	2.21	0.75

It appears then that the essential change that takes place during ripening is a change of the starch into soluble carbohydrates, which consist principally of cane and invert sugars and dextrins. Oxygen is necessary for the working of this process. There are also some tannin and mucilaginous substances in the green banana. There is little waste in the ripe banana, as 70 per cent. of the solids is edible, and most of the edible material is a sugar which is easily assimilated.

One reason why bananas have sometimes been found to be indigestible is probably because they have been picked too green and are eaten when imperfectly or unevenly ripened. They should be so ripe that none of the mucilaginous quality remains, and the odor that indicates the imperfectly ripened fruit should be absent. "The banana, especially when *cut* not torn from the stem, is one of the most perfectly sterilized packages of food that appears on the market."

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[1] J. A. C. Soc., Vol. 34, p. 1729.

Banana Flour

is difficult to make a flour from most fruits, as they become
y or horny on drying, but from certain selected varieties of
anana, and especially from the coarser variety known as the
ain, at the right stage of ripeness, an excellent flour can be
. This is a fine powder somewhat granular in appearance,
as a yellowish color, and agreeable taste. Says Thompson,[1]
scussing the dietetic qualities of this flour, "The finest banana
called "bananose," at the end of one and one-half hours of
reatic digestion, was capable of developing twice as much sugar
e same quantity of oatmeal or farina, and approximately one
ne-half times as much sugar as cornstarch. Saliva when sub-
ted for pancreatic extract produces a similar effect. Banana
is made into a thin gruel or porridge by the addition of either
or milk, and eaten with cream it constitutes a delicious
ighly nutritious article of diet, suitable in cases of gastric

and stored away for use during that part of the year (four months) when the fruit cannot be obtained from the tree. This paste ferments and has a disagreeable odor, but after baking it yields a pleasant and nutritious food. Another and more common method of preserving the fruit is to cut it in thin slices and dry in the sun.

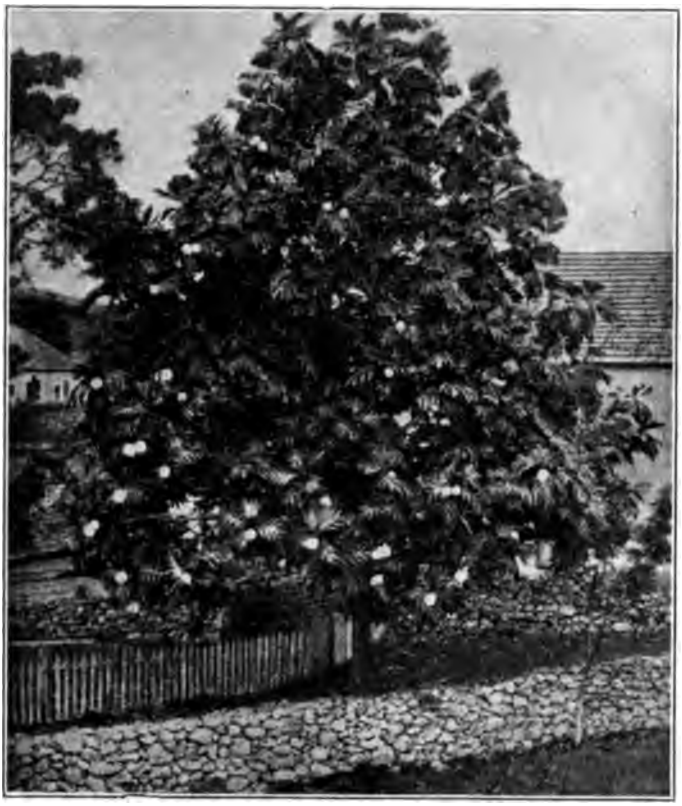

FIG. 48.—The bread fruit tree. (By permission World's Commercial Products.)

FIG (Ficus carica)

The fig, like the olive, has been cultivated in oriental countries from the earliest times. (Fig. 49.) The fig, the olive and the nd from Greece and Spain. Recently the Smyrna fig has troduced into southern California, Arizona, Georgia, Texas and other American states, and is grown very ully. More than 15,000,000 pounds of figs are annually d into the United States.

GUAVA (Psidium guajava)

guava originated in Central America and the West Indies ow grown throughout tropical countries, and in the United n southern California and Florida. The fruit grows on a ee. There are numerous varieties, both small and large, und, like an apple, and some pear shaped.

pulp has an aromatic flavor and is generally made into nd preserves. It contains about 80 per cent. of water and ent. of carbohydrates. The guava jelly, cream, pastes, the market contain 75 to 80 per cent. of sugar, and very fish products. "Mango chutney" is a well-known sauce imported from India.

OLIVE (Olea europaea)

From a study of ancient writings it is evident that the wild olive flourished in Asia in prehistoric times. The cultivated trees were originally grown in Asia Minor, Palestine, Greece and many parts of southern Europe. Most of the olives at the present time are grown in Italy, Greece, France and Spain, and the cultivation is becoming an important industry in Mexico, Central and South America, Arizona and California. Olive trees were planted at the San Diego Mission in California as early as 1769.[1] The favorite varieties for pickling are; the Mission, Manzanillo, Ascolano, and Sevillano.

FIG. 50.—The mango tree. (By permission, World's Commercial Products.)

The tree, which is a small gnarled evergreen, with light sage leaves, (Fig. 51) may be propagated by the seeds, "tips" kers, or by layering, but the nursery-man generally prefers the tips or small branches which are started as slips. The equires good soil and a sufficient quantity of rain, unless an be irrigated. In the olive orchard great care is exer-

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[1] U. S. Dept. Agric. Bull. No. 803. 1920.

fruit, either green or ripe, dried olives, which have an astringent taste, olive or "sweet" oil, and the pomace or oil cake which is a valuable cattle food.

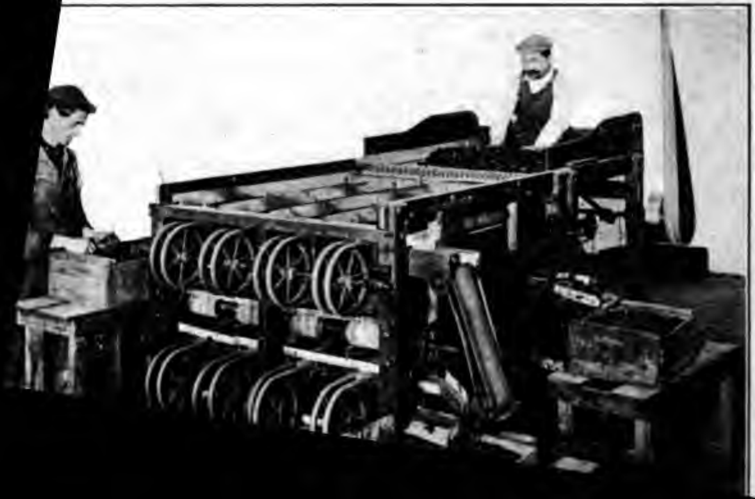
Pickled Olives

For making green olive pickles the fruit is picked by hand about six weeks before it would ripen, and is placed in lye, 1 to 2 per cent. for some hours, to remove the bitter taste; then it is soaked and washed in fresh water several times and pickled in several brines of increasing strength and finally packed for shipment, in brine that has been recently sterilized by boiling. Olives should remain in this brine for two or three months before they are ready for use.

Ripe olives have a purplish-black color, when prepared for market, and are by many preferred to the green olives. At the canneries in California and elsewhere, the method of preservation is to soak several times in caustic soda solution, until the lye reaches the pit. The olives are next washed repeatedly until the lye is completely removed and then they are salted in brines of gradually increasing strength, and finally put into cans with a 3 to 4 per cent. brine, and processed in a water bath. As thus prepared they may be regarded rather as a food than a relish. (Fig. 52.)

Since ripe olives, especially samples preserved in glass vessels, have recently caused several deaths in various parts of the country, the U. S. Dept. of Agric. has investigated the cases and finds that the olives are rendered poisonous by the presence of certain bacteria, which have been identified as *Bacillus botulinus*, which are present because the packers have failed to heat the containers to a sufficiently high temperature to destroy all the dangerous bacteria that may be on the fruit. Of the thousands of cases that have been examined only a very small percentage were found to contain the poisonous olives. Since the attention of packers has been called to this danger, and on account of the vigilance of rities, little further trouble is anticipated from this

anufacture and use of olive oil is discussed under Fats p. 318.



and of a reddish-green color. The juice is remarkable as containing an active proteolytic enzyme, *papain*, which has a powerful influence upon proteins, so that an infusion of the fruit or leaves will, when applied to a piece of tough meat, cause it to become tender in a few minutes.

POMEGRANATE (Punica granatum)

The pomegranate is one of the earliest of the fruits mentioned in history. It is indigenous to Persia and Afghanistan, and is grown throughout tropical countries. Mention is frequently made of it in the ancient religious and mythological writings. The red edible pulp which surrounds the seeds of the fruit (berry) has a sweet sub-acid taste, and is often mixed with water and sweetened to make a cooling beverage. It is used to make salads and as a constituent of ice cream. In South America the juice is used to furnish, by fermentation, an intoxicating beverage called "aguardiente."[1]

PRICKLY PEAR OR TUNA (Opuntia)

In various sub-tropical countries as Italy and Sicily, southwestern United States and Mexico, grows a cactus which bears an edible fruit that is much prized by the natives. The varieties grown in other countries are known as Indian fig by the Englishmen, the Barbary fig by the Frenchman, and the "higos chumbos" by the Spaniard.[2] The fruit, which is of the ordinary cactus form, is covered with bunches of fine spines and is of a reddish-yellow or purple color. It is handled by brushing off the spines, slicing off each end and after cutting transversely, pressing out the interior. The small bony seeds are rejected. The pulp has a sub-acid taste suggesting that of the cucumber or watermelon. It contains about 11 per cent. of sugar and small quantities of other nutrients. The fruit bears transportation fairly well, and may be

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[1] Foods, etc., Tibbles, p. 658.

[2] The Tuna As Food for Man, U. S. Dept. Agri., Bu. Pl. Ind. Bull. No. 116.

for several months. Some of the tuna products that are
used in Mexico are "miel de tuna," a kind of sirup having
ickness of honey; "melcocha" and "quoso," which are con-
ted sufficiently so that they crystallize on standing; and
tunas. A fermented beverage called "colonche," a kind of
ent use" beer, is also prepared from the tuna.

PINEAPPLE (Ananas sativa)

e pineapple is indigenous to America, and grows especially
n Central America, the West Indies, and Hawaii. It is

does not increase after they are picked, as is the case with bananas, fruits picked too green and allowed to ripen lack greatly in sugar and in delicious flavor. If picked green the pines contain only 2–3 per cent. of sugar, while if ripened on the plant they contain from 9 to 15 per cent. The flavor and odor of pineapples is due to the essential oils and ethers which are present in very small quantities. The "best shippers" are often the varieties which we get in our markets, and little attention is paid to the quality of the fruit. The canned Hawaiian pineapples have found such great favor, because they are allowed to remain on the plants until they are practically ripe. Canned pineapples are prepared in Singapore and the Straits settlements, and also in the Bahamas, Hawaii, Florida, and other sub-tropical countries. If carefully sterilized, they may be put up without sugar, and thus prepared lose, in the process of canning, very little of their delicious flavor. The juice from the canneries is now concentrated to furnish a sweet sirup which is used in the place of the sugar in canning the fruit. Some of this is also put on the market as "pineapple sirup."

Dietetic Value

The pineapple is one of the most valuable of foods from a physiological standpoint. It is considered particularly useful as an aid to digestion, as it contains a proteolytic enzyme called "bromelin," which is closely related to trypsin. This ferment converts albuminous matter into peptones and proteoses, and acts in acid, alkaline or neutral media.

CASHEW APPLE (Anacardium occidentale)

This fruit, to which is attached the cashew nut, is a native of the West Indies. (See p. 333.)

GARDEN FRUITS

The fruits of this class are raised from the seed which is sown annually. The plants are generally vines, and the fruit rests

the ground as it ripens. Most of these fruits are grown for
diate use, although a few of them like the pumpkin may be
for winter consumption.

CITRON

he citron is a small variety of watermelon which is nearly
and almost tasteless. It is used for making preserves, which
bles that made from the genuine citron.

CUCUMBER (Cucumis sativa)

he cucumber is one of the fruits of the natural order Cucur-
eæ, or the Gourd family, which appear to be indigenous to
érn India, although it has been cultivated from the earliest
ric times, in Syria and Egypt. It came into general use in
and in the seventeenth century. In Egypt cucumbers are

with dill seeds. No less than 3,000,000 bushels of pickles (cucumber) are consumed annually in the United States.

Pickles were formerly adulterated by the use of salts of copper to give them a green color and an appearance of freshness. The author has found an amount of copper corresponding to one-seventh of a grain of crystalline copper sulfate, in a medium-sized pickled cucumber. The use of copper salts for this purpose is not allowed in the United States for goods that enter interstate commerce. Alum is also a common adulterant of pickles, and is added with the object of producing hardness and crispness in the product, and also in order to assist in the preservation of the pickles. In most of the states of the Union the presence of alum in pickles must be stated on the label.

EGG PLANT (Solanum melongena)

The egg plant, called the aubergine in England, is indigenous to India, but is a common fruit in the West Indies, southern Europe and throughout the United States. The fruit, which is egg shaped, sometimes white, but more frequently purple, and as large as a cocoanut, grows something like a pepper on the stalk. As it contains 93 per cent. of water its nutritive value is very low. It is usually prepared for eating by cutting in slices and broiling or frying.

MELON (Cucumis melo)

A study of the origin of melons indicates that they were originally found wild both in India and Africa. They were introduced into China in the eighth century and into southern Europe about the beginning of the Christian era. The French melon, which has a dark yellow flesh, is the variety generally cultivated in Europe. In the United States numerous varieties are grown, including the "musk melon," "nutmeg melon," "Casaba" or winter melon and the "cantaloupe." The latter was named from Cantaloupe in Italy, where it was first grown in Europe. A variety grown under irrigation at Rocky Ford, Colorado, is noted delicious taste and odor. The same variety raised from Ford seeds, is common in other parts of the country.

WATERMELON (Citrullus citrullus)

e watermelon is supposed to be indigenous to Africa, but cultivated throughout the central United States and in rn Europe, Egypt and India. This melon grows best on y soil which is well fertilized and in a country where there abundance of sunshine. The vines may cover the entire the time of fruiting, and the melons often have a weight of unds or more. They are much valued during the warm s, especially in hot countries, for their sweet, juicy pulp. terior is red or pink, and the seeds, which are numerous, are white or black.

termelons bear shipment very well, but should not be before they are ripe. Immense quantities are sent from

As the nutrient material of the squash amounts to 9 per cent., and that of the pumpkin to only 5 per cent., it is evident that the squash is a more valuable addition to the dietary than the pumpkin.

VEGETABLE MARROW (Cucurbita ovifera)

This is more commonly grown as a garden vegetable in England than in the United States. One variety, known as the crown gourd "simlin," or "custard marrow," bears a flattened fruit with scalloped edges, and is sweeter than the true marrow. This fruit is eaten while quite young, and is boiled to prepare it for the table.

TOMATO (Lycopersicum esculentum)

History

The tomato is a native of America, probably either Mexico or Peru. It was formerly known as the "love apple," and was grown only for ornamental purposes. Its Mexican name is "tomatl," while the French still call it "pomme d' amour." Probably on account of the fact that it belongs to the Nightshade family, like the potato and capsicum, and as this family includes many poisonous plants, it was regarded with suspicion as an edible vegetable until about 1850, when it began to be grown, and a taste for it was acquired. This is a good illustration of what can be done, and often is done in cultivating the taste for a new variety of food.

Soon after being introduced into Europe, the tomato was grown extensively on the shores of the Mediterranean, where the climate is admirably adapted to its production. The plant does not flourish in England, as it requires a higher temperature and a longer season than is there afforded. It grows well throughout nearly the whole of the United States.

In order to allow sufficient time for the tomato to fully ripen, the season is usually extended at the beginning by sowing the seed in a hotbed, and setting out the young plants as soon as the danger of frost is past. In southern countries, as parts of Calia, the tomato is actually a perennial, and can be grown at any of the year. In Florida and Texas, the plants are started in ember, so that the ripe fruit may be put on the northern et in the early spring.

he young plants are set in rows about 4 feet apart in both tions, and as they become larger they may be supported by es to keep the vines and the growing fruit from the ground. n tomatoes which are used for pickles, preserves, chow-chow, as well as ripe tomatoes find a ready market. Much has been in improving the varieties, and the characteristics most ed at present are good flavor, smoothness, even ripening, and medium size cavities, and thick walls, so as to be suited ng distance transportation.

Composition

he tomato contains 93 per cent. of water[1] and only 4 per of carbohydrates, including sucrose, dextrose and levulose

In the process of canning, the skins, cores, and unripe portions should be rejected. The sealed cans are sterilized by being allowed to remain in a bath of hot water or brine for a sufficient length of time. Experience has taught the packer how much time and how high a temperature is necessary for this process. Just as with other canned fruits, lack of care in the preparation will be shown by a high per cent. of "swells," which indicates that fermentation is taking place.

There is little excuse for the adulteration of canned tomatoes, and at the present time chemical preservatives are seldom found. Even the use of coal tar colors, or cochineal to cover up the fact that unripe and imperfect fruit has been used, is practically a thing of the past. The most common fraud in canned tomatoes is probably the use of too much water in the product.[1] In some states legal standards for the weight of the solid fruit have been fixed, as for instance, the "Fancy" grade must contain not less than 20 ounces of fruit in No. 3 can, the "Standard" grade not less than 18 ounces of ripe fruit exclusive of juice. Cans have been examined which contained as low as 7.1 ounces of solid fruit. 15,000,000 cases of tomatoes, of 24 cans each, are annually put up in the United States.

Tomato Ketchup (Catsup)

Ketchup, which is so universally used in the United States, demands more than a passing mention, especially since it has attracted much attention from being one of the fruit products that was formerly preserved by the addition of chemicals, especially sodium benzoate and salicylic acid. The standard for tomato ketchup as adopted by the Association of official Agricultural Chemists is as follows: "Ketchup is the clean sound product made from the properly prepared pulp of clean, sound, fresh, ripe tomatoes, with spices, and with or without sugar and vinegar."[2] Although one-tenth of one per cent. of sodium ben-

[1] Bulletin N. Dakota Ag. Ex. Sta., Vol. 1, p. 240; p. 300.

[2] U. S. Dept. Agri., Bu. Chem. Bull. No. 119.

sometimes badly fermented, and to
with coal-tar colors, and use a liberal amount of
tives. In the best grades of ketchup, however,
tices are now permitted. A bottle of ketchup
opened, when not in actual use be kept in th
Robinson says, "For the consumer, it is far bett
should ferment and thus not be consumed by
unwholesome, unclean product be taken into t

Tomato Paste

Tomato Paste is made by crushing the frui
seeds and skins and evaporating in a vacuum
the volume, or for a special variety to one-t
This is flavored in various ways, and its us
rapidly increasing in the United States. *Chi*
basis pulped tomatoes, and is flavored with r
vinegar and spices.

Tomato Seeds

The extraction of oil from tomato seeds wa
a firm in Parma, Italy, in 1910. This is us

CHAPTER XI

FUNGI (MUSHROOMS), LICHENS, AND ALGÆ USED AS FOOD

MUSHROOMS

The fleshy fungi known as mushrooms have been used as food since the time of Pliny and perhaps earlier. In the vicinity of Paris mushrooms have been cultivated since the sixteenth century.[1] There is an erroneous opinion prevalent that all poisonous fungi belong to the class called "toadstools," while the edible varieties are classed as mushrooms.

Edible Mushrooms

The Agaricus campestris (Fig. 55), which is common in the United States and Europe, consists of a centrally placed stalk from 2 to 6 inches in height, in the end of which is borne a cap-shaped portion known as the cap. The color of the plant varies from white to brown and on the cream or white stem a short distance below the cap is borne a ring or "annulus." On the under surface of the cap are numerous "gills." Between these folds is a blackish-brown powder which consists of innumerable purple cells, termed spores, which take the place of seeds and serve for the reproduction of the mushroom. Each spore is capable of germination and will produce a thread-like growth in the soil. This is called the spawn or more properly the "mycelium" of the mushroom and is what is sown in beds. On these threads are subsequently formed little nodules which are the earlier stages of the growth, and with favorable rains the mushroom grows from these nodules almost in a single night. Mushrooms differ very much from ordinary green plants, for there are really no roots, stems or leaves.

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[1] U. S. Dept. Agri., Farmers' Bull. No. 204.

Mushroom Growing

he mushroom industry has been more fully developed in :e and England than in the United States. The best place

than to shut out the light. The proper temperature for growth ranges from 53 to 60° F. Abandoned stone quarries or coal mines have been utilized for mushroom growing, but the beds must be so arranged that they are well drained. The beds are constructed of well composted stable manure, and in this the spawn is sown. Beds will come into bearing within eight weeks after they are sown, and often continue to bear for two or three months. The propagation of the spawn or "bricks" used for seeding the beds requires considerable skill and careful attention to the conditions of temperature and moisture.

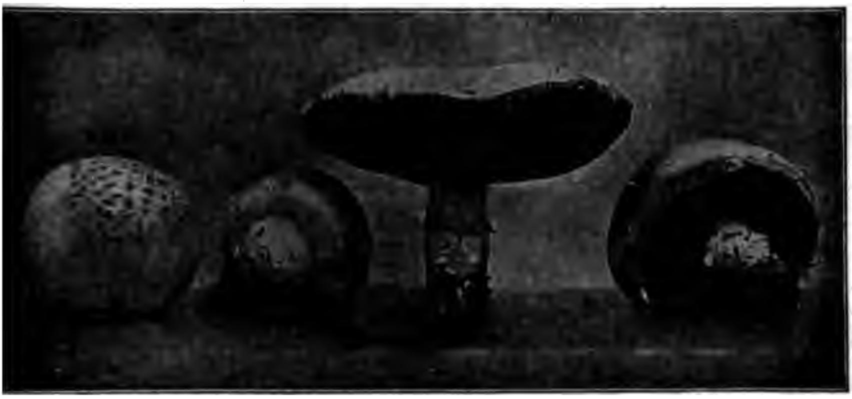

FIG. 55.—Common mushroom, *Agaricus campestris*. Edible.—(F. V. Coville, Circular No 13, Division of Botany, Department of Agriculture.)

Composition and Digestibility

Notwithstanding much that has been written by enthusiastic mushroom lovers about the value of these fungi as a food product, the chemical analysis does not sustain this opinion. Comparing the different varieties it will be seen that the general composition is as follows:[1]

Water 89 per cent. to 92 per cent.; total nitrogen 0.15 per cent. to 0.60 per cent; albuminoid nitrogen 0.15 per cent. to 0.37 per

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[1] U. S. Dept. Agri., Farmers' Bull. No. 79.

non-albuminoid nitrogen 0.12 per cent. to 0.30 per cent.; pro-
25 per cent. to 3.75 per cent.; fat 0.20 per cent. to 0.50 per
carbohydrates 1.4 per cent. to 3.5 per cent. Beefsteak with
mushrooms have sometimes been compared, contains on the
e 19.50 per cent. of protein and 17 per cent. of fat. It has
hown by Mendel and others that from 30 to 40 per cent.
nitrogen is not available as food, since it is in the form of
or other non-protein bodies, and most of the cellulose is
sted. That they often have a meaty flavor and like the
ctives" in meat excite the gastric activity is not denied, but
annot be compared to meat in their nutritive constituents.

In the process of cooking, the mushroom shrivels considerably, and loses some of its extractives, thereby losing some of its flavor. As it absorbs water at the same time, the final result of cooking is that stewed mushrooms contain only about 2 per cent. of solid matter.[1]

Mushrooms are not readily digested in the stomach. This may be partly due to the peculiar character of the cellulose, which seems to become somewhat coagulated and "leathery" during cooking.

Poisonous Mushrooms

There seems to be no rule by which the ordinary consumer, unless an expert, can distinguish between edible and poisonous mushrooms. Practically the only safe way is to purchase those mushrooms that have been cultivated and are known to be edible. Canned mushrooms, since they are put up by those who are familiar with the business, have very seldom produced any injurious effects. It is well to be cautious about deciding on the quality of wild mushrooms, by following any published "rules" for their selection. Gibson, one of the authorities on mushrooms, says, "Avoid every mushroom having a cup or suggestion of such at the base; the distinctly fatal poisons are thus excluded; exclude those having an unpleasant odor, a peppery, bitter or other unpalatable flavor, or tough consistency; exclude those infested with worms or in advanced age or decay." (Fig. 58.) The cup above mentioned sometimes called the "death cup," is known by botanists as the volva and at first encloses the entire plant, just as an egg shell does an egg. The stem lengthens with the growth of the plant and in doing this ruptures the bag or cup. This underground portion is shown rather imperfectly in Fig. 57.

The symptoms of mushroom poisoning are exceedingly varied, since there are numerous poisonous varieties and they contain different harmful ingredients. In general the symptoms are vomiting and diarrhœa, followed in some cases by stupor, cold

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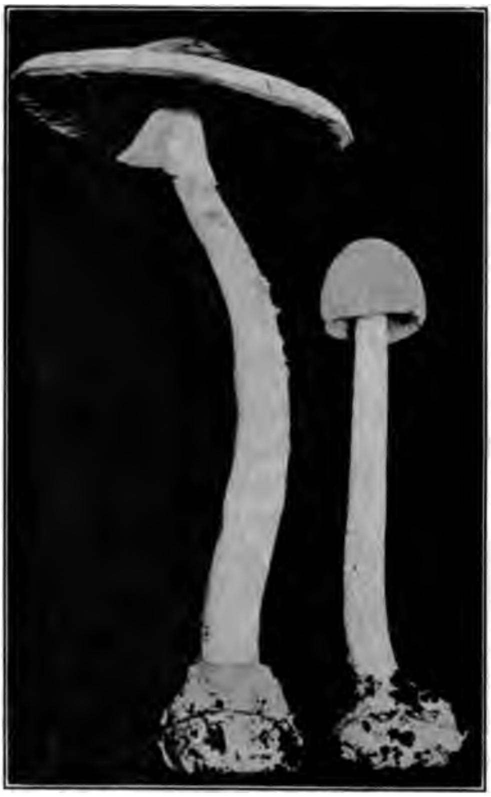
[1] J. C. Soc., Vol. 61, p. 227.

The "Morel" is a mushroom having a hollow stalk and coni-
pitted cap. They are exported in a dried condition from
rmany, and are especially used as a flavoring for soups, sauces
d gravy. The term "champignon" is applied in France to the
aricus and frequently to mushrooms in general.



. 58.—Deadly Amanita (Amanita phalloides), very poisonous. (By permissio
E. A. White, Ct. St. Geol. and Nat. Hist. Survey.)

Truffles

"Truffles" are underground fungi found growing wild, espe-
lly in England, France and Italy. They were known as ear

e fourteenth century, and have always been much prized
heir flavor. They seem to grow best in the shade of nut-
ng trees, and are propagated by spores like mushrooms. The
e grows just beneath the surface of the soil to about the size
potato and may be red, white or black. The most famous
ty is the Périgord Truffle which is named from the French
nce, where it is found. In England dogs are trained to
the truffles, while on the Continent hogs are taught to dis-
them by the peculiar fleshy odor which they emit. They
sed for garnishing dishes, and in flavoring soup and gravy,
value depending on their size, aroma and texture.

Preservation of Mushrooms

common method of preserving mushrooms is by drying.
may be strung by means of a needle and thread, and dried in
un, or over the stove, and when needed for use may be soaked
d water. Large quantities of dried mushrooms are exported

Germany. The total quantity imported for the year ending Dec. 31, 1919, was 2,085,676 pounds, which is only one-third the quantity annually imported before the world war.

ALGÆ

Under the term algæ are included several varieties of seaweed, which are used as food. The most important of these is Irish moss or Carrageen, which is used both as ordinary food and in the dietary of invalids. It is abundant on rocky shores, especially those of Ireland, and grows from three-quarter tide to below low water mark. Several species of this seaweed are used. They are boiled for several hours until a slimy pulp is obtained, and this is sometimes made into cakes with oatmeal and fried in butter, or with vinegar and pepper is made into a sauce.

Composition

The chief constituent of Irish moss is a kind of mucilage which is known as "lichenin." The dried moss has been found by Church to contain 9.4 per cent. of nitrogenous matter and 55.4 per cent. of mucilage. As this mucilage is not affected by the saliva or pancreatic juice, and as the nitrogenous matter is not all of the digestible class, there is considerable question as to the nutritive value of this material.

Other edible algæ are the alaria or "murlins" of the north coasts, the dulse of the Scotch and Irish coast which forms a welcome addition to the potato diet of the peasants, and the agar-agar or Chinese gelatin of the Orient. The Phillipinos make a gelatin from sea weed by extracting it with boiling water, and drying the gelatin obtained on cooling. One part of this product with 300 parts of water, makes a firm jelly on cooling.

Edible Bird's Nests

The edible birds-nests, which find so much favor with the Chinese cooks are prepared from a semi-transparent substance made by

in swallow-like birds that nest in high, rocky cliffs especially
he shores of Siam and the Malay Archipelago. The nests
by the birds from material obtained from algæ which they
er, are robbed by the natives, but the birds patiently build
that they may rear their young.

LICHENS

he most important edible lichen is Iceland moss. It grows
dantly in the Arctic regions, and is sometimes made into
d or boiled with the milk of the reindeer. The bitter principle
) which the moss contains is partially removed by soaking in
ak solution of sodium carbonate. The jelly-like substance
ined by boiling the Iceland moss with water consists largely of
nin or moss starch $(C_6H_{10}O_5)_n$ and iso-lichenin. Although
substances are only slightly affected by the ordinary diges-
juices, this moss must afford some nutriment, as it is an

CHAPTER XII

ANIMAL AND VEGETABLE FATS AND OILS

Fats and oils may be divided into two general classes:

1. Essential or volatile oils.
2. Fixed oils and fats.

The essential oils are entirely different in their composition and properties from what are ordinarily known as fixed oils. They are volatile constituents of plants, and can usually be driven off unchanged by heat. As they are important constituents of Spices, a more complete discussion will be found under that head. (See p. 440.)

Fixed oils or fats are from two sources, viz: animals and vegetables.

Many of these substances are important constituents of foods, while others, differing only slightly in chemical composition, are utilized in various industries, as the making of soap, candles, paints, etc. Many of the animal oils, such as whale-oil, seal-oil, and fish-oil, are not agreeable to the taste ot civilized people, but even these when properly treated and "hydrogenated" are used in increasing quantities as food. Most of the vegetable oils, if properly refined, make good food products. Vegetable oils are most frequently found in greatest abundance in the seeds of plants, and are extracted by pressing the ground or crushed seed, or by extracting with some solvent like gasoline. Animal fats on the contrary are obtained from the animal tissues by a process of "rendering," or heating until the fat is melted, so that it can be separated from other animal matters.

Composition

Considered chemically, fats are glyceryl esters of fatty acids, or they may be looked upon as salts of the higher saturated or urated fatty acids in which the glyceryl acts as the base. s nitric acid when treated with caustic soda forms water odium nitrate (Chili salt peter), so stearic acid will theoret- combine with glyceryl to give glyceryl stearate (ordinary n). Some of the fatty acids contain a relatively higher rtion of hydrogen than others; those to which more hydrogen e added we term *unsaturated*, while those that are fully sup- with hydrogen we speak of as saturated. To the former belong oleic and linoleic acids, and to the latter stearic, tic, arachedic acid, etc.

rdinary tallow is composed largely of stearic, palmitic and cids combined with glycerol to form glycerides. The phys- ndition of the fat or oil, *i.e.*, whether it is a solid or a liquid at ary temperatures, depends largely on the relative propor- of the saturated and unsaturated glycerides present.

Hardening of Oils

active in hydrogenating fats. In the process a small amount of the metal is introduced into the fat, which is at the same time heated in a current of hydrogen to a temperature of from 100° C. to 225° C. The metal used is, after the completion of the hydrogenation, removed by filtration.[1]

Saponification

When fats or oils are "saponified" by treatment with caustic soda or potash the corresponding soap is formed, and commercial glycerine remains in the mother liquor, from which it may be separated and afterward purified by vacuum distillation.

VEGETABLE AND ANIMAL FATS

Vegetable fats usually contain more of the unsaturated, and animal fats more of the saturated glycerides. On this account the animal fats are more frequently solid and the vegetable fats are more often liquid, in which case they are known as oils. The liquid condition of the vegetable oils is rather an advantage than otherwise, as far as ease of digestion is concerned.

In the extraction of the fat or oil from the animal or vegetable tissue, it is difficult to avoid obtaining other substances which are not oils. These impurities are mechanically mixed, and therefore most oils must be purified and refined before they are fit for use as food.

ANIMAL FATS

The common animal fats used as food are lard, beef fat (suet), mutton fat, butter, and small quantities of the fat of the hen, duck, goose, etc. By the process of "rendering," the fat is separated from the connecting tissue, which settles to the lower part of the kettle as "scrap" or "cracklings."

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[1] Chem. Abs., Vol. 6, pp. 2550–2551.

LARD

here are several grades of hog fat, sold under the name of as made at the large packing houses. The highest grade h is known as "Leaf Lard" or occasionally as Neutral Lard r, is made from the fat surrounding the kidneys. This fat, h has been washed and chopped, is heated at as low a temture as possible, in steam-jacketed kettles, as there is les ring of the residual matter and consequently the product is lighter color than when the fat is heated in an open kettle. fat thus obtained is sometimes washed with water containing le salt and sodium bicarbonate.

"Steam rendered Lard," or "prime steam lard," is the lowest grade of the packing house. It is extracted from the "stock," under a pressure of about 50 pounds, by admitting steam to the tank which contains the hog fat from various parts of the animal. When the material is completely "rendered," the fat is run off from the scraps, and quickly cooled. "Kettle rendered" lard should be of a high quality, and the process should be similar to domestic practice in which the kettle is heated externally, and the temperature used is not excessive.

Lard is frequently stiffened by the addition of lard stearin, but the use of beef stearin for this purpose would be considered an adulteration. Lards thus stiffened "stand up" better in a warm climate, and are therefore more satisfactory.

Lard oil is obtained by subjecting the lard contained in woolen bags, to hydraulic pressure. The oil which is expressed is chiefly olein, and is of a pale yellow color and has a peculiar bland taste. It was formerly used as a burning oil for lamps, and at the present time finds some use as an edible oil and for lubricating purposes. In France it has been used as an adulterant for olive oil. The stearine which remains in the press is known as "lard stearine," and is used in making "Compound Lard," and for similar purposes.

Lard Substitutes

On account of the cost of pure lard, a large number of substitutes have been proposed, and some have found a very extensive use. As long as they are sold under their true names as substitutes, if they are carefully made of clean, wholesome material, there can be no objection to their use. Vegetable fats and oils are by many believed to be more wholesome than lard and they contend that lard substitutes are really better for general use from a hygienic standpoint. Compound lard, which is sold under various trade names, is a mixture of such materials as cotton-seed oil, lard stearine, beef stearine and sometimes lard. The cotton-seed oil used is purified then bleached by filtration through Fuller's

before being mixed with the other ingredients. A variety
ades of different melting point are put upon the market for
in different climate and at different seasons of the year.
rogenated oils are also used in these mixtures, and the products
oming into very general use as substitutes. There is to-day
he market a great deal more lard substitute, which contains
vegetable oils, with sometimes about 12 per cent. of beef
ine, than compound lard, which according to the rulings of
U. S. Dept. Agric. must contain an appreciable amount of
These shortenings are advertised and sold under distinctive names, as "Snowdrift," "Crisco" and "Flake White."

Uses of Lard

ard like other fats is readily assimilated, and quite completely
ted in the intestines. Its use as "shortening" diminishes
dhesiveness of the flour, and prevents the pastry from being
h. When used for "deep frying," if the temperature is too
i.e. from 480° to 570° F. some of the fat is liable to be

ents of the meats. Suet is sometimes used in the place of lard, or mixed with lard in the cooking of food, although it is not as satisfactory for general domestic use. Oleo stearine is consumed in large quantities by lard substitute manufacturers and the oleo oil commands a good price because of the great demand for it by the oleomargerine makers especially abroad. These fats are of great importance in the industries of soap and candle making, for which the lower grades may be used.

GLYCERINE

A by-product in the manufacture of soap is (glycerol) glycerine ($C_3H_5(OH)_3$). Although not in itself regarded as a food product, yet as a constituent of fats it is of interest. In the process of making soap, the glycerol remains mixed with the excess of alkali, in the liquor from which the soap has been separated. After as much as possible of the common salt has been separated from the spent lye by evaporation, the "mother liquor" is treated with various chemicals, especially a sulphate of iron[1] which precipitates many of the impurities which are then filtered off. The clear liquid is next evaporated in a vacuum pan, until the crude glycerine reaches such a density that it contains about 80 per cent. of glycerol. It is then distilled under a very high vacuum with superheated steam, and passes over with the steam and is afterward concentrated, until it reaches a specific gravity of 1.262. This is filtered and sold as dynamite glycerol. A purer product is obtained by bleaching, filtering and redistilling the crude glycerine. The properties and uses of this sweet, bland, unctuous liquid are too well known to require description. (For Butter Fat see p. 406.)

VEGETABLE OILS

Most of the "cold-drawn" vegetable oils from seeds and fruits are suitable for use as edible oils, or for the packing of fish. It is especially important in the preparation of edible oils that they be y free from fatty acids. To bring about this result alkalies lkaline earths are used in the process of manufacture. These re more satisfactory if they do not congeal at temperatures e the freezing point of water. Olive oil usually fills this nd, but some other oils like cotton-seed oil and peanut oil first be "demargarined" or "winter pressed" before they satisfactory. To accomplish this the oil may be stored in vinter in large tanks where the stearine settles or crystallizes and from which the clear, supernatant oil is drawn off, but nercially the oil is usually cooled to so low a temperature the "stearine" may be removed by filtering, pressing or ng through a centrifugal.

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[1] Outlines of Industrial Chemistry, Thorp, p. 348.

Use of Vegetable Oils

or the production of heat and energy in the body, the vege- fats are very valuable. As compared with sugar, fats are and one-fourth times as effective, and are, therefore, to be ded as a highly concentrated form of nourishment. The oils cooked with steam or water is that when the material becomes saturated with fat it is so protected that the digestive juices cannot readily come in contact with the carbohydrates and proteins of the food. If food products are to be cooked in deep fat—the process used in cooking doughnuts—it is important that the temperature be sufficiently high so that very little fat is absorbed.

A. H. Church[1] gives the following list of oil-bearing vegetable products with the percentage of oil present in each:

	Per cent.
Cocoanut (meats)	36
Palm (kernel)	48
Palm nut (pulp)	65
Brazil nut (seeds)	67
Almond (kernels)	54
Ground nut (peanut)	52
Sesamé (seeds)	51
Poppy (seeds)	45
Olive (pulp)	39
Olive (kernels)	44
Cacao (seeds)	44
Hemp (seeds)	32
Walnut	32
Cotton (seeds)	24
Sunflower (seeds)	22
Oatmeal	10
Corn (maize)	5

Soy beans contain 20 per cent. of oil, and Rape seed 40 per cent.

Mustard seed, tomato seed, raisin or grape seed, apple seed, apricot and peach kernel contain enough oil to be of some commercial importance.

Palm kernel oil is made from the kernels of the palm nut after the removal of the pulp. This is used in the manufacture of butterine and butter substitutes, and is sold as vegetable butter under various proprietary names.

Palm oil is obtained by boiling the pericarp of the palm-nuts with water, and skimming the oil from the surface.

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[1] Food, p. 36.

used in tin plate making and in the manufacture of
. In many tropical countries, especially in Africa and the
ppines, there are numerous varieties of palms, from the soft
of the fruit of which, palm oil is obtained. It is semi-solid at
ary temperatures, has an agreeable taste and odor, and in the
tries where it is produced is extensively used for food pur-
. The chief constituent of palm oil is palmitin. As this oil
de by the natives, by the crudest methods, it often contains
impurities. These are removed and the oil is bleached by
us processes, before it is put upon the market for food
oses.

lmond oil, which is especially used for pharmaceutical pur-
, is obtained from either the bitter or the sweet almond.
former contains a greater percentage of oil and is more
ally used for this purpose. Bitter almonds are grown most
dantly in the countries around the Mediterranean Sea, in
a and the Canary Islands. The glycerids[1] in almond oil

seed, poppy-seed and other less expensive oils. Peanut oil on account of its taste, odor, and fluidity is valuable as a salad oil, and as such should be sold under its true name. It is also an excellent substitute for lard as "shortening," or in other culinary processes. It is superior to most oils for "deep frying," as it does not burn as readily as olive oil, and can thus be heated to a higher temperature. The United States imported 20,540,317 gallons of peanut oil in 1919.

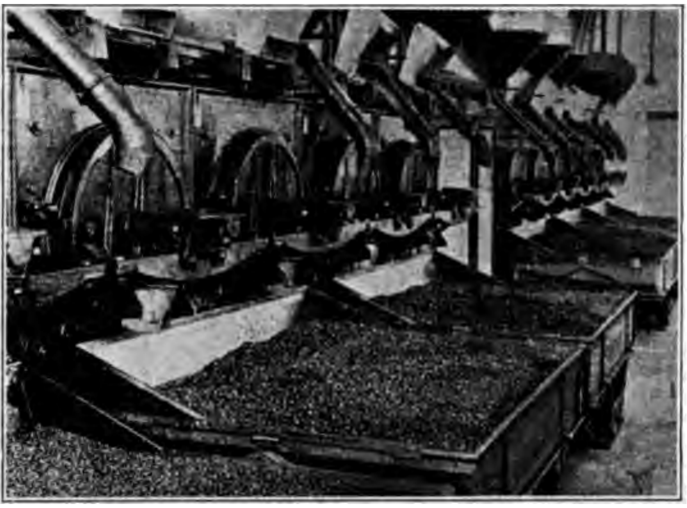

FIG. 60.—Peanut roasters. (By permission U. S. Dept. Agric.).

Sesame oil, also called oil of benné, is obtained by pressing the seeds of the *Sesamum orientale L.* The plant is a native of southern Asia and is grown for the seed in India, China, Japan, the Levant, Mexico, and West Africa; but the commercial preparation of the oil is mostly carried on in the south of France.[1] The best grades of sesamé oil are a golden yellow in color, free from any disagreeable odor or taste, and may be used in the place of olive oil as a salad oil, or in making oleomargarine. The cheaper grades are utilized for making soap and for lighting purposes.

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[1] Foods and Their Adulteration, Wiley, p. 408.

Poppy-seed oil may be made from the black or white poppy s. These are grown for oil and for opium in Europe, Turkey, ia, India and China and Germany. The better grades of oil f a light color, and have an agreeable taste, while lower grades darker in color, and possessed of a strong taste. This oil is h used abroad as a salad oil. It is frequently adulterated with per oils,[1] such as sesamé and hazel nut oil.

with water and again pressed for a second grade of oil. The mass may be heated before the next pressing or the pomace may be extracted with carbon bisulfide or petroleum ether. When these solvents are distilled off, the oil remaining is used in the manufacture of "castile soap," and in the textile industry. After the high grades of oil are extracted, they are still further purified by being run into tanks and washed with water, allowed to stand until the pulp and gummy material settles out, then the oil is carefully drawn from the top (Fig. 61). Olive oil may also be filtered to improve its appearance, and is finally retailed in glass or tin containers, but is said to keep better in the latter as it is protected from the light. (See p. 322.)

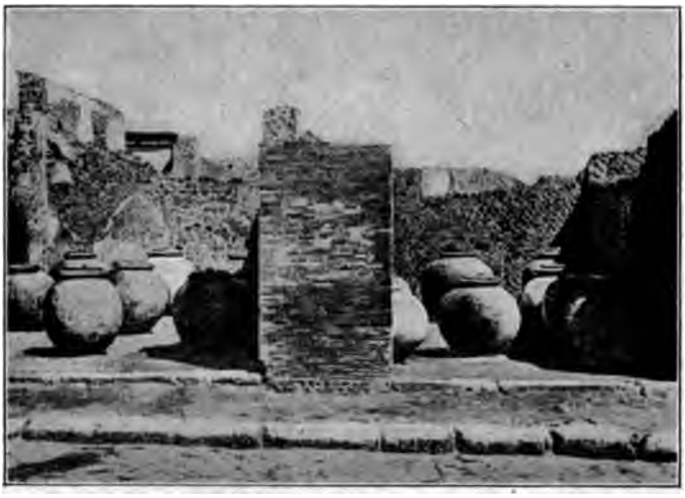

Fig. 62.—Olive oil jars found in Pompei.

Adulteration of Olive Oil

In regard to adulterations, that most common all over the world has been the adulteration of the olive oil with some cheaper substitute. The oils especially used for this purpose are cottonseed oil and peanut oil. Rape-seed oil and poppy-seed oil are adulterants in Europe, but not so frequently used in ted States. These adulterations are readily detected by analysis, and the pure food laws of most countries and at the present time sufficiently well enforced so that the of fraudulent olive oil on the market is not large. There jection, from a hygienic standpoint, to the use of cotton- or peanut oil for making salads and for other culinary

roasted and crushed cacao beans or nibs. (See p. 480.) A little potassium or sodium carbonate is sometimes mixed with the mass before pressure to neutralize any free fatty acid that may be present. Cacao butter has a pleasant odor and a flavor suggestive of chocolate, and is extensively used in pharmacy, in the manufacture of chocolate, candy, and in the preparation of perfumes. On account of its high price, it is frequently adulterated with cocoanut oil, palm nut oil, bees wax, paraffin and even tallow. It is important to distinguish carefully between the cacao (Theobroma cacao L.) and the coconut (Cocos nucifera L.), a species of palm.

Coconuts, since they are abundant and cheap in the tropics, have long been used as a source of fat. The coconut palm grows on the low-lying coast lands of the West Indies, Panama, tropical Africa, India, the Malay Archipelago and the islands of the southern Pacific. (See p. 335.) Special names are applied to different grades of oil, and these names came from the country where the oil originated. Thus "cochin" oil cames from Malabar, "Ceylon" oil from the island of that name—"Copra" oil is the term applied to the oil obtained from the sun-dried kernels; this is prepared by the natives by boiling the kernels with water and removing the fat by skimming.[1] "Poonac" is the name of the oil cake after the extraction of the oil, and is a valuable cattle food. Most of the oil on the market is made from the copra, usually by pressing. Large quantities of dried copra are imported into this country and used here for expressing the oil.

Coconut oil is semi-solid at ordinary temperatures. It has an agreeable taste and odor, and keeps well, if free from fatty acids. It is commonly believed that the oil becomes readily rancid, but this is a mistake if the oil is good in the beginning. Coconut oil may be used in the preparation of food, especially the so-called "nut margarines," by bakers and biscuit manufacturers and in making oleomargerine and candies, but it is also largely used in the United States in soap and candle making. It is seldom oil is extensively used abroad for culinary purposes, under various

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[1] Foods, Their origin, Composition and Manufacture, Tibbles, p. 359.

erated on account of its cheapness. A pure neutral coconut
extensively used abroad for culinary purposes under various
ietary names such as "Vegetable Butter," "Conut," "Vege-
," "Coconut Butter," etc.

otton-seed oil is made from the seed of the cotton (gossypium
ceum), and other species. Cotton is grown in Egypt, India
n the United States in the South and as far north as the
ern part of Virginia, Missouri and Oklohoma. The seed[1] is
assed through machines which remove the "linters," or short
n fibers, which are afterward used in making cotton felt.
leaned seeds are then transferred to a huller where the hull
ken, and separated from the kernel in a winnowing machine.

The dark yellow oil which runs from the press must be purified. It is first allowed to stand until some of the impurities settle out, when the clear oil is drawn off and agitated with from 10 to 15 per cent. of caustic soda solution at 100 to 110° F. for forty-five minutes. The residue which settles out after this treatment is drawn off and used for soap stock.

The yellow oil thus prepared is often further purified by again heating and settling, by filtration, or especially for winter use, by chilling until some of the stearine crystallizes out. This is the "cotton-seed stearine" of commerce, and is used in the manufacture of compound butter and lard substitute, and also in making candles. A still lighter colored oil may be made by filtering through Fuller's earth.

The summer yellow oil is of a golden color, and the winter yellow is more or less demargarined so that it shall not become cloudy in winter from the separation of the stearine.

As a food the oil has rapidly grown in favor as the quality of the oil upon the market has been improved. Within comparatively recent years an oil that is practically tasteless and odorless can be purchased. It is as wholesome as an animal fat, and is admirably adapted to many culinary uses.

The growth of the cotton-seed oil industry is one of the most remarkable instances of the utilization of by-products. For many years the plant was grown exclusively for the fiber, and the seeds were thrown away or burned. It is estimated that the products now obtained from cotton seed alone, in a single year in the United States, are worth over $500,000,000.

Sunflower seeds, although containing considerable oil, have not been utilized practically in the United States as a source of oil.[1] In some European countries sunflower seeds are eaten as an ordinary food. The plant is extensively cultivated in S. Russia, Hungary, Italy, India and China for food purposes. The oil is palatable and makes, without refining, an excellent salad dressing. The finest grade is made by the cold pressure of the l seeds, and a reddish oil is expressed hot from the roasted . The residual oil cakes are as valuable as cotton-seed oil for feeding purposes.

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[1] U. S. Dept. Agri., Div. Chem., Bull., No. 60; also Bull. 687.

orn oil (maize oil), which is made from the germs of the grains h can be separated in the process of milling, is coming into general use in the manufacture of food products. The germ ins over 20 per cent. of oil, the odor and taste of which are able and are due to the presence of a volatile oil.[1] Most e corn oil of commerce is obtained as a by-product from h and glucose factories. This oil contains, besides palmitic, ic and arachidic acids, small amount of an unsaponifiable ance mostly lecithin. It is used as an edible oil, frequently l with other vegetable oils, also in the manufacture of oleoarine, lard substitutes, etc. The lower grades are used for ng soft soap and very largely in rubber substitutes. (See p. 45.)

ape, Colza or **Rübeen** oil made from rape seed is an excellent or culinary purposes. That made by cold pressing of the

French" is practically apricot-kernel oil, or a mixture of this with peach-kernel oil.[1]

The Soy bean (see p. 195), which grows in China and Japan, has been more recently cultivated in southern Europe and in the United States It contains 18 to 19 per cent. of oil, which is of such a good quality that it will no doubt come into more general use all over the world.[2] This oil is one of the very few which can be used as a food and in paints and soaps. It is being imported to the extent of 200,000,000 pounds into the United States annually and is taking the place of large quantities of cotton-seed oil for domestic consumption.

Tomato seeds have been recently employed, especially in Italy, as the source of an edible oil. An edible oil is also made from *grape seeds.*[3]

To the list above discussed may be added a large number of foreign nuts and fruits that yield oils and fats. Many of these are edible and are in common use by the natives of the respective countries where they grow. The methods used for extraction of the oils are so crude that the product is frequently of a much lower quality than if modern methods were used. Some of these oils are as follows:[4] Cohune oil from the Cohune palm of Central and South America;[5] Borneo tallow, from a fruit grown in Borneo; Mafura oil from the East African Coast; Kokum butter made from seeds grown in India; Sheanut oil, made from a seed grown in West Africa and used in making "margarine"; Butyracea fat, used in India for the adulteration of "ghee", Candle nut oil made from a seed grown in China and Australia; and rice oil, made from the rice bran.

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[1] Chem. Tech. Anal. of Oils, Fats and Waxes, Lewkowitsch, 5th. Ed., Vol. II., p. 323.

[2] U. S. Dept. Agri., Farm. Bull. No. 372, 687.

[3] Bull. Sci. Pharmacol (3), 26, 105–10; U. S. Dept. Agric., Bull., 632.

[4] Fatty Foods; Bolton and Revis.

[5] D. Cons. and T. Rep., 1914, p. 1323.

CHAPTER XIII

NUTS, AND NUT PRODUCTS

lthough in many countries some varieties of nuts have used as food for a long period, in the United States, until aratively recent years, the tendency has been to regard as a luxury, or a confection, rather than as a food. Many e nuts in common use, if compared in price with the more nsive forms of breakfast foods, are not an expensive food. e imported nuts were an expensive luxury, the native nuts, as hickory nuts, walnuts, butternuts, chestnuts, hazel nuts ecans, were formerly to be had by any one for the gathering; n most parts of the United States this is still the case.

is an abundance of starch. As nuts usually contain but little water, they afford a very concentrated form of nutriment. Those having a high fat content—upward of 60 per cent.—are the pecan, brazil nut, butternut, filbert, candle nut, hickory nut, pine nut, and walnut. Those especially rich in protein—over 20 per cent.—are the pignolia, a pine nut from Spain, peanut, butternut, almond, beechnut, candle nut, paradise nut, and pistachio. Those which are prized for their starch content—over 40 per cent.—are the acorn, chestnut, water chestnut, chufa (earth almond), and the ginkgo nut.

Digestibility

The digestibility of nuts has been quite extensively studied at various Agricultural Experiment Stations, notably that of California. If the true composition of nuts was better known and they were used understandingly, they would not have the reputation for indigestibility that they have obtained. As has been shown above, compared with ordinary foods, like meats which often contain 70 per cent. of water, they are a very concentrated form of nourishment, and so should not be eaten in large quantities, especially when the stomach has already been filled to repletion. We should look upon nuts as food, just as we are beginning to regard sugar as food, and use them as such in proper quantities and at the right time, and they will prove extremely valuable and occasion no discomfort. The experiments that have been made[1] with fruit and nut diets seem to indicate that nut protein is about as easily, although possibly not as completely digested, as the proteins of bread and milk.

It is true that a diet composed exclusively of fruits and nuts contains sufficient nutrients in the right proportion to support life, but experiments have shown that the protein from a mixed diet is more economically utilized than that from a single food, or a very limited variety. On this account those who use nuts in the place of meat should not depend upon nuts alone as the food useful nuts on the market.

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[1] Loc. cit.

as purchased, varies from peanuts 1775, to butte

Cooking

Some nuts are improved in flavor and als
digestible by cooking. In the United States the
although often eaten raw, is much improved in fl
bility by roasting or boiling. It is the cooked ch
favor as an important food material in Euro
Italy and France. Chestnuts are often used for
and the combination of the starchy chestnut
which is rich in protein and fat, makes a well b

Nut Preparations

Nut butters, especially peanut butter, on
agreeable taste and nutritive qualities, are c
general use as a substitute for ordinary butt
also made from nuts with the addition of sugar

In the preparation of nuts for market, unsh
pecan are often polished by rotating in revolv
little pigment or dye is sometimes added to im

them in boiling hot water and then rubbing off the thin coat thus loosened.

Shelled nuts are at present very common on the market. As the meats are sometimes picked from the shells under most unsanitary conditions, and as dust and dirt are very liable to settle on them, they should be washed, preferably with hot water, before being used.

Another use for nuts is in the making of coffee substitutes. Peanuts and acorns are generally used for this purpose; but only a small proportion of the nuts is soluble in hot water, so these beverages are not very nutritious.

NUTS

The following nuts are in common use in various parts of the world:

Acorn; the fruit of various species of oak (Quercus).

Almond; the fruit of the (Amygdalus communis) var. Dulcis and Amara.

Beech nut; the fruit of the (Fagus sylvestris) or (F. Americana).

Brazil nut; growing on the (Bertholletia excelsa).

Cashew nut; from the (Anacardium occidentale).

Chestnut; the fruit of the (Castanea dentata).

Canarium nut, Pili nut, or Javanese almond (Canarium indicum) (C. ovatum).

Chufa (earth almond), a bulbous root.

Chinkapin; growing on the (Castanea pumila).

Coconut; the fruit of the (Cocos nucifera).

Ginkgo nut; the fruit of the (Ginkgo biloba).

Hazelnut; the fruit of the (Corylus avellana, C. tubulosa, and C. grandis).

Hickory nut; the fruit of the (Hicoria ovata).

Paradise nut; grown on the (Lecythis usitata).

Peanut; a leguminous pod bearing the seed of the (Arachis hypogœa).

ecan nut; the fruit of the (Hicoria pecan).
ine nut; the fruit of the pine (Pinus edulis, P. monophylla).
istachio nut; the fruit of the (Pistacia vera).
alnut; the fruit of the (Juglans nigra).
alnut (white); the fruit of the (Juglans regia).
alnut (butternut); the fruit of the (Juglans cinerea).
alnut (Japanese); the fruit of the (Juglans sieboldiana).
itchi nut; not a true nut but the fruit of the (Nephelium
).

corns were at one time extensively used in the United States ttening swine, but they are becoming less abundant as the ry is more thickly settled. They contain 45 per cent. of h and sugar and 37 per cent. of fat.

corn flour[1] has been used as food especially among the North ican Indians. In the preparation for use as human food the are leached to remove the tannin and bitter principles, and after beating them into a meal, this is made into a porridge ush.

almonds, especially the soft-shell variety, are usually marketed in the shells.[1]

Jordan almonds, a hard shelled variety, with a thinner integument and more delicate flavor than other varieties, are imported from Malaga in southeastern Spain, and command the highest price in the market. (Fig. 65.) There is some doubt as to the origin of the name "Jordan," as some believe that this variety was first introduced from the vicinity of the river Jordan, while others contend that the word is simply a corruption of the French word "jardin," garden.[2]

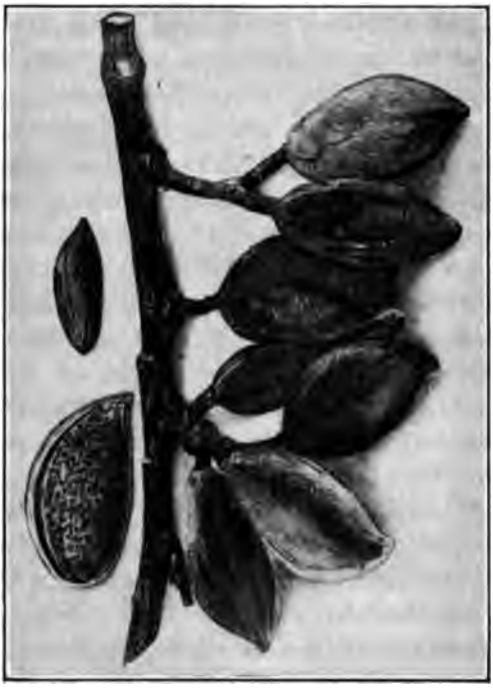

FIG. 65.—Jordan almonds. (By permission U. S. Dept. Agric.)

Besides being used for eating, almonds are ground into a flour ısed for making paste, bread, and "*marzipan*" or "*mareh-*" Some varieties of nuts are eaten before they are fully red. In many parts of Europe and in California, green ıds are found in the market and are considered quite a ıcy. The kernel is easily separated from the immature shell ›ulp by the use of a knife.

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[1] U. S. Dept. Agri., Bu. Chem. Bull. No. 160.
[2] U. S. Dept. Agri., Bu. Plant Ind. Bull. No. 26.

he **bitter almond,** while not very poisonous when fresh, has a reeable taste, and this, in addition to the fact that one of ›roducts of the decomposition is hydrocyanic acid (HCN), s it undesirable as a food. They are grown in large quantities ıthern Europe, however, and are the chief source of "oil of almonds." Much of the prussic acid of bitter almonds is ›ated in the process of cooking, and small quantities of these ıds may be used as a flavor. On account of the fact that ıds do not contain starch, but only sugar, gum, fibro-cellulose, at, they are of value in the diet of diabetic patients.

he pit of the bitter almond, like that of the peach, apricot, and members of the *prunus* family, contains a glucoside called

This is the fruit of a large South American tree which will not withstand the climate of the United States. The nuts are borne in a large dry shell which contains about twenty nuts closely packed together. They are quite liable to become rancid when kept too long.

The **Sapucaia or Paradise** nut, which is borne by another tree of this same family, is about as large as the Brazil nut, and has a rough shell, but is usually not so much curved as the Brazil nut. It is of finer quality, and more delicate texture, but has not yet become common on the market in the United States. It contains but little starch or sugar.

The **Canarium nut** or **Javanese almond,** known also as the *Pili nut*, which is highly appreciated in the Orient, has recently been introduced into the United States from the Philippines, and by the immigrants from Asia and the East Indies. The tree is native in the East Indies and the Philippines. The nuts are spindle shaped, with a triangular cross section. The shell is very thick and hard and incloses a white oily kernel, which is comparatively tasteless. The kernel is eaten in the Moluccas, both raw and roasted. These nuts are often used to mix with other nuts of a higher price in making up lots of mixed nuts. An oil is expressed from the nuts which the natives use for table purposes and in lamps.

The **cashew or maranon** fruit and nut, a native of tropical America, grows readily in the East and West Indies, South America and the Philippines. It is a small oddly shaped yellow and red fruit, 2 or 3 inches long, of pyramidal form, and bears at its distal end the nut or seed, which is small and kidney shaped. (Fig. 66). This arrangement of the seed outside the pulp of the fruit is remarkable. The seed is inclosed in a grayish-brown cellular coat that contains an essential oil which has a blistering effect upon the skin, due to the presence of cardol and anacardic acid.[1] The ripe fruit and nut are eaten in Brazil and India, and the fermented juice is used to make a wine which by distillation a spirit much like rum. A similar intoxicating drink called " is made by the natives of eastern tropical Africa. The s said to be poisonous, owing to the presence of hydrocyanic but after it is roasted an agreeable flavor similar to roasted nuts is produced. The fruit is generally used as a preserve.[1] the nut a nutritious oil similar to almond oil is expressed.

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[1] Phil. Jour. of Science.

he **chestnut tree** grows readily in the eastern part of the United States, especially toward the north. It does not have so large a range as some of the other nut-bearing trees. For many years the finest chestnut trees have been cut for lumber in the American forest, so that few of the original trees now remain. A serious blight has recently appeared in New England and farther west which threatens to

The composition—starch and sugar 43.1 per cent., fat 6.3 per cent., protein 6.5 per cent.—shows the chestnut to be one of the most valuable starchy foods, so that it may well replace Indian corn (maize) in the dietary. Single-kerneled chestnuts have been grafted on original stock in some localities, producing a larger variety. The *chinkapin* is a smaller nut, which grows on a low tree or shrub, closely related to the chestnut, in the southern and eastern part of the United States.

FIG. 67.—A coconut grove. (By permission Central Scientific Co.)

The **horse chestnut** (Esculus hippocastaneum) is common throughout the temperate regions of Asia, Europe and America. Although it contains an abundance of starch (68.25 per cent.) it is only fit for use as food for the lower animals, because of its containing tannin and sapotoxin, which cannot be readily removed. The North American Indians are said to have sometimes used the horse chestnut as food.

The **coconut** is the staple food of many of the natives of the islands of the Pacific. (Fig. 67.) The meat of the coconut encloses the "milk" which is gradually absorbed as the nut reaches

the nut-cracking factories located in
the meats are picked out, and sorte
halves, and shipped to the northern mar
tion the pecan trees begin to bear withi
they are set out. The kernels contain
more than is contained in any other veg
are also fairly rich in proteins. They ar
States, and when we consider the imm
nuts of various kinds that are import
there seems little danger that the growi
as the pecan will be overdone.

There are several pines that yield
are called "pinons." These grow m
and eastward to Colorado and New
produced in southern Europe and In
form quite a valuable addition to th
itants. The American Indians former
nuts, and at the present day their des
quantities for the market. The pine
produced must be roasted so that t
ficiently to permit the separation of th

The **pistachio** or "green almond" grows on a tree that is a native of Syria. It has been cultivated in southern Europe and in the southern United States and California. The kernel of the Pistachio nut has a greenish color with a red pellicle. This nut is salted, while still in the shell, by putting into brine. The fruit, which is a drupe, is produced in clusters, and has a smooth stone which easily separates into two halves at maturity. The seed is blunt at one end and rather pointed at the other. To the radicle, which is located at the more acute end of the kernel, two large green cotyledons are attached. The thicker portions of the seed coat contain a dark red coloring matter, while the thinner portions are colorless and show the green color of the cotyledons beneath.[1] These nuts are highly prized both on account of their greenish color, and for their pleasant, rather resinous flavor. They are used to ornament and give flavor to ice cream and confectionery.

The **walnut** tree (black walnut) grows wild over a large portion of the eastern and central United States. On account of its value as lumber, great forests of these trees have been cut down. The nut is rich in oil, but does not remain sweet after the first winter.

English (white) walnuts are supposed to have come originally from Persia, but are now grown more extensively in south and southeastern France, and more recently in California. The trees are planted in rows, and cultivated with frequent fertilization with manure and commercial fertilizers. These orchards are very valuable when once started as fruit producers. The outer pericarp or husk can be readily removed from the nut at the time of picking. They are sometimes prepared for the market by bleaching with chloride of lime, or other bleaching agents, and polishing with soapstone is occasionally resorted to in order to improve their appearance. An excellent oil is extracted from the nuts.

The **butternut** is rich in fat and is closely related to the walnut, but by many it is considered as having a finer and richer flavor.

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[1] U. S. Dept. Agri., Bu. Chem. Bull. No. 160.

grown especially in the northern United States and in Canada. nut contains water 4.4 per cent.; protein 28 per cent.; fat er cent.; sugar, etc., 3.5 per cent. It is oval in shape, while valnut is nearly spherical. The tree does not grow to as great as the walnut, nor is the wood in as great demand for lumber.

'he **litchi,** *lichee* a so-called Chinese nut, is not a true nut, but properly a fruit protected by a nut shell. It is rich in starch sugar (77 per cent). This nut is imported by the Chinese the United States and is regarded by them as one of the best products of China. They are often dried in the sun or cially, for winter use. The Chinese use them in tea, in the of sugar on account of their sub-acid flavor. They grow in a, India and the Malay Archipelago, and must be dried or erved in tins for export.

'here are several nuts of less importance grown in various s of the world. Among these may be mentioned the bread the candle nut of the South Sea Islands, the ground nut of pe the kola nut of Africa, the quandang nut of Australia, the

CHAPTER XIV

MEAT AND MEAT PRODUCTS

Flesh foods afford in general more concentrated nourishment than vegetable substances. This concentration which has been made in the animal body, generally by the use of vegetable substances, furnishes a food containing much protein and a small quantity of starch or sugar. The fat of the food which is necessary for the growth and nutrition of the body may come either from the vegetable or animal kingdom, and the balance of the ration can be built up by the use of a variety of foods containing starch and sugar. The legumes and nuts are the only vegetable foods that contain large amounts of nitrogenous material, and they are extremely useful in a mixed diet. (See p. 188.)

ANIMAL FOOD

Animal food may be classified in accordance with its origin into that from (1) mammalia, (2) birds, (3) fish, (4) other sea food, and (5) miscellaneous.

The common animals used for food include such domestic mammals as beef cattle, swine, sheep, goats, horses, camels and reindeer. Of less importance are wild mammals such as the deer, elk, moose, alpaca, llama, guanaco and antelope. Some carnivora, especially the badger, bear and raccoon, are often used for food, and among rodents the rabbit, hare, squirrel, marmot (wood chuck), beaver, hedgehog, porcupine and opossum. The mammalia living in salt water, namely, the porpoise, whale, narwale, walrus and seal, are in some countries utilized as food.

MEAT

he term meat generally includes not only the muscular tissue an meat, but all that is purchased, as meat including fat, ons, skin and bones. As beef is a standard meat, it is con- nt to study its properties as typical of the whole class. The nt of fat in meat varies within wide limits, and may be as s 3 per cent. in beef to 90 per cent. in fat pork. Usually meat having from 8 to 12 per cent. of fat distributed through considered the most satisfactory. In an emaciated animal w as 2 per cent. of fat is sometimes found in the lean tissue, n a carcass which is in the condition for a good grade of beef gh as 8 per cent., and in an extremely fat carcass 22 per cent. t is found distributed through the lean tissue.

Structure of Meat

leat is made up of muscle fibers held together by connective

Slaughtering Meat

In discussing the slaughtering of meat, H. W. Wiley says[1] "The principal thing to be considered is first a sudden, and in so far as possible, a painless death of the animal; second, the immediate withdrawal of the blood of the slaughtered animal, if slaughtered otherwise than by opening the principal artery; third, the removal of the intestines and hair or hide of the animal; fourth, immediate cooling at a moderately low temperature until the animal heat is entirely radiated; fifth, the cutting of the carcass into the usual form for consumption and the removal and utilization of the débris for food or other purposes; sixth, the delivery of the meat, if to be eaten in a fresh state in a condition secured from contamination and decay until it is in the hands of the consumer; seventh, the curing of the meat in a proper manner by salt, sugar, vinegar and wood smoke, and the delivery thereof in an unadulterated form to the consumer."

In many of the large cities there is upon the market a variety of meat known as "Kosher" meat, which is killed by a "Shohet" or expert meat inspector, under the laws of the Jewish Talmud.

Keeping Meat

After slaughtering, the meat undergoes several changes. Immediately after being killed the flesh, especially in young and well-nourished animals, is juicy and tender. On account of the clotting of the myosin, after a short time *rigor mortis* ensues and the meat becomes stiff and hard. In the third stage to which the meat soon passes, it becomes again soft and tender, owing in part to the action of lactic acid on the sarcolemma and connective tissue. This process should not, however, be allowed to go too far, or the meat will become "high" and have a disagreeable odor and flavor.

This development of the lactic acid rendering the meat tender, is called "ripening" of the meat. Refrigeration retards this process, hence meats can be kept fresh for a considerable time at a low temperature (below 40° F.). The experiments by P. F. Trowbridge,[2] show that as long as the amount of lactic acid continues

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[1] Foods and Their Adulteration, Wiley, p. 14.

[2] Missouri Agri. Exp. Sta.

crease the meat appears to be improving in quality. At a
in stage, however, basic bodies begin to separate, which
ralize the lactic acid and thus cause a decrease in the amount
is free acid. The meat is still edible after this decrease has
n, but whenever enough basic bodies are liberated to neutral-
ll the lactice acid, the meat has then reached a stage of incip-
putrefaction and is no longer fit for food.
ame is often allowed to "hang" until the changes of decom-
ion are well marked and in this condition it is highly relished
picures.

Chemical Composition

he different cuts of beef differ quite widely in composition,
ndent on the location of the "cut," and the quality or grade
ef. This is well illustrated in the following analyses taken
Mo. Ag. Ex. Sta. Bulletin:

A VERY HIGH GRADE OF BEEF

	Moisture	Fat	Protein	Ash

The flavor of meat depends on the amount of nitrogenous extractives—the creatin, creatinin, xanthin, etc., present. The amount of these "meat bases" is small—from 4 to 15 grains only per pound in ordinary meats. When these are removed by boiling, the meat is almost without flavor. Only a trace of the nitrogen present is in the albumoses and peptones. It is stated that not far from half of the nitrogen in water-soluble flesh consists of the extractives and half is coagulable proteins.

Cooking Meats

The cooking of meats has been very thoroughly studied.[1] Among civilized people meats are usually cooked before they are eaten, because this process improves the taste and makes them more palatable, injurious animal parasites and bacteria are destroyed and finally the tissues are thoroughly softened so that they can be readily attacked by the digestive fluids. In the process of roasting or boiling a moderately large piece of meat, the interior never reaches a temperature above 190–200° F.[2] The time required to roast a piece of beef depends on its size, shape, etc., and the temperature of the oven. For example, a single short rib roast containing the bone, required 16.3 minutes per pound to cook the meat rare, while the two-ribbed rolled roasts averaged 20.1 minutes at the same temperature to reach the same conditions. If the roast is quite completely covered with fat, the heat penetrates only through the lean portions exposed.

Roasts are as quickly cooked at an oven temperature of 175° C. (347° F.) as at 195° C. (383° F.), so the higher temperature involves a waste of fuel. There is much less danger of overcooking the meat at the temperature of 100° C. (212° F.), than at a higher temperature, but of course a much longer time is required to raise the temperature of the interior. By slow cooking, however, the interior is in a much more uniform condition.

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[1] U. S. Dept. Agric. Office Exp. Sta. Bul. No. 162.

[2] Bul. Univ. Ills. Vol. 55, No. 19; U. S. Dept. Agric. Farmers' Bull. No. 162.

n regard to the treatment of meat with water, research s[1] that 13.56 per cent. of the total protein existing in lean beef, uble in cold water. Of this soluble protein, 90.00 per cent., a form which is coagulable by heat from a neutral solution, 8.40 ent. exists as albumoses, and a very small portion apparently s as peptones. A 10 per cent. solution of salt water will extract as much protein from raw meat as will pure water.

n the process of cooking, raw meat loses considerable weight. own by Grindley[2] the average of ninety-one tests of the per- ge loss of nutriment in uncooked meat when boiled for three s is water 45.07; protein 7.25; fat 11.70; ash 44.62. In other experiments, the actual loss in weight by boiling a piece ound" beef was 38.32 per cent.; the loss in weight by the proc- f roasting was 30.10 per cent.

he chief loss during the cooking of meat is evidently water.[3] n beef is pan-broiled (fried in a hot pan without the addition) there appears to be no important loss of nutritious material. cooked with water loses from 3 to 20 per cent. of nutrients, n is, however, found in the water as extractives and can ents is desired. In boiling meat better results are attained if it is plunged immediately into boiling water. A "pot roast," in which the amount of water used is small, and this is concentrated near the close of the operation, is a very satisfactory product.

THE DIGESTION OF PROTEIN FOODS

In the digestion of meat the first change is the swelling up and softening of the fibers in the stomach. The harder the connective tissue the less these fibers separate so they can be acted on by the gastric juice, and hence pounding, or chopping tough meat adds to its digestibility.

In the stomach the free HCl acts upon the proteins of the food,[1] converting them into meta-protein acid albumin ("syntonin") which under the influence of pepsin splits down with the formation of proteoses, and these by further hydrolysis yield peptones. (See table, p. 20.) This digestion of the proteins takes place mostly after the food has passed the stomach, and when it reaches the small intestine the proteins are attached by "tryspin" and "erepsin," active enzymes or ferments found in the pancreatic juice and in the intestines, to produce finally numerous monamino and diamino acids and other bodies.

The digestive products of the proteins pass on by absorption, as amino-acids mainly into the capillary blood-vessels, and thence to the portal vein and into the circulation. There is abundant evidence to prove that the proteins may be the source for the ultimate production of carbohydrates and to some extent of fats in the body.

The following list of comparative digestibility of common protein food, will serve as a partial guide for use of these foods.[2] The most digestible are given first and the least digestible last. Oysters, soft-cooked eggs, sweet-bread, white fish, or any fish not rich in fat, chicken, lean beef, eggs (scrambled), mutton

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[1] Chemistry of Food and Nutrition, Sherman, p. 100.

[2] Thompson, loc cit.

, crisp bacon, fowl, tripe, lamb, corned beef, veal, ham, and game, salmon, mackerel, herring, roast goose, lobsters rabs, pork, smoked, dried or pickled fish or meats.

Preservation of Meat

he general methods for the preservation of food have been ly discussed (p. 212).

old storage is perhaps of more importance for meat products for any other class of perishable foods. By its use the abun- beef and pork of the central West can be transported to the ard and to distant countries; the cheap beef of the South ican plains can be shipped to Europe, America, or other n lands. Smoking and drying are common methods of rvation of meat.

rying is particularly applicable to beef though occasionally for other meats. "Jerked" beef is the name applied to dried in North and South America, and "Biltong" is the African for dried strips of meat, especially that of the antelope and

Meat prepared for the English market is usually treated with borax in addition to other preservatives. In the United States the use of borax in meats intended for interstate commerce is not permitted.

CANNED MEATS

The portions of the carcass used for canning depends on the demands of the trade and the condition of the market for fresh meat. The meat used for this and other purposes is, in the United States, under government inspection,[1] in all establishments whose products go into foreign or interstate commerce. (Fig. 69.) Both ante-mortem and post-mortem examinations are made by the Government inspectors at the time of slaughter, and carcasses that are unfit for food are sent to the "tank" department to be worked up into fertilizers. The meats to be used for "curing," making sausage or chopped meats, for making

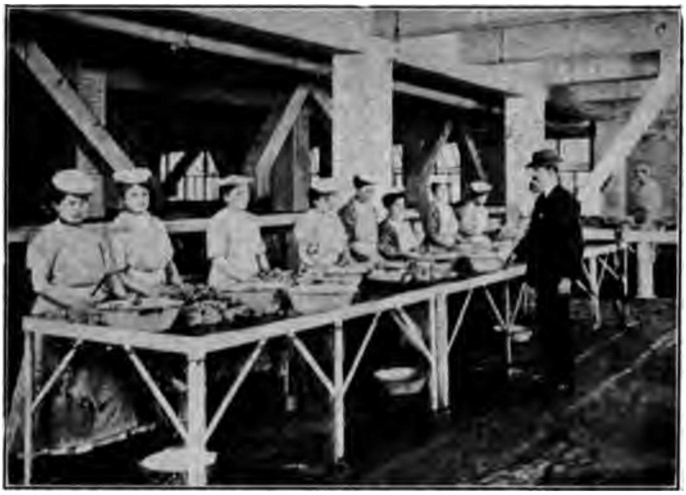

FIG. 69.—Preparing pig's tongues for canning, under the supervision of a U. S. Inspector. (By permission U. S. Dept. Agric.)

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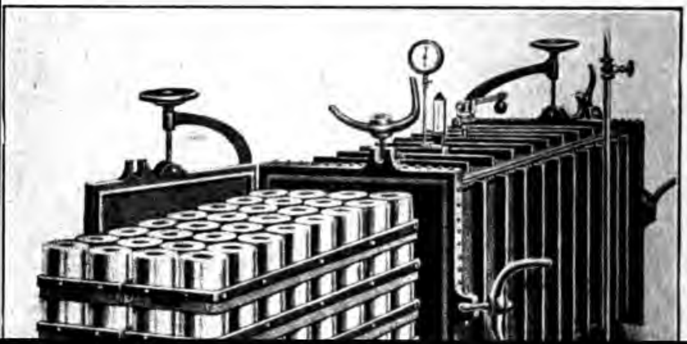
[1] U. S. Dept. Agri., Bur. An. Ind. Order No. 137.

rd and tallow, and for canned products are reinspected they enter these departments. These regulations apply to the meat of cattle, sheep, swine or goats.

The Process of Canning Meats[1]

eces of meat of about equal size are selected for canning, so they may be uniformly sterilized in the process. The first



animal extractives, salt and sometimes sugar or molasses, and fills up the "voids" between the pieces of meat. The tins are then closed and the covers are soldered on, a hole being usually left for the escape of the gases or air inclosed within the can. The filled cans are sterilized by heating with steam in strong boilers under pressure. (Fig. 70.) After some time the cans are hermetically sealed by a drop of solder, and then "reprocessed" at a temperature of 225° to 250° F. for one or two hours.

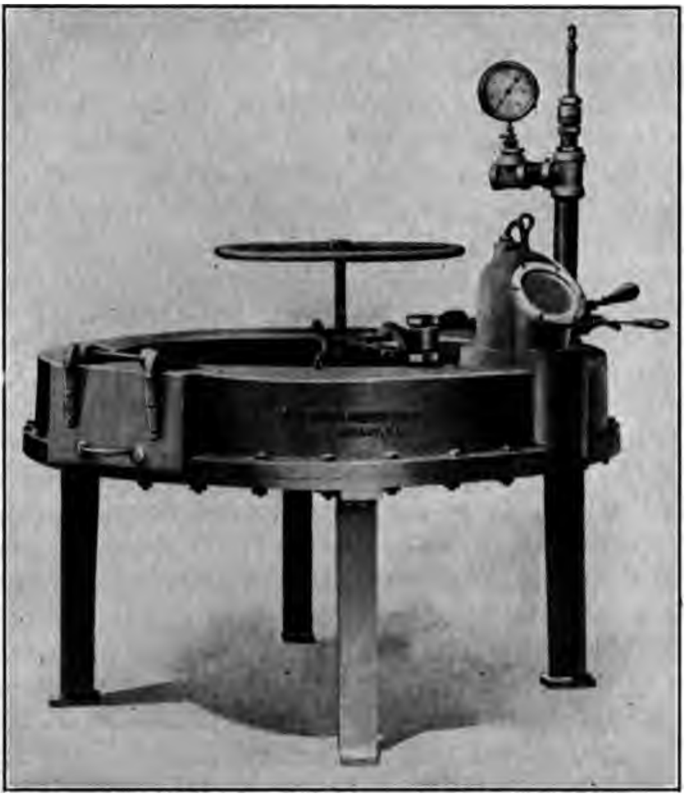


FIG. 71.—Sealing cans of meat in a vacuum.

In some establishments the filled cans are placed in a machine where they can be exhausted in a vacuum (Fig. 71), sealed autocally while in this exhausted state, and then removed to a of oil or some other liquid where they are heated to a temture of 240° F. for as long a time as seems desirable. Experis made in the laboratories of the U. S. Department of Agrire show that "a can of 26.9 ounces of beef contains as an ge content an amount of meat equivalent to 42 ounces of beef, and retains practically all of the nutrient value of arger quantity of fresh beef.

am and bacon are canned for use in tropical climates or in ons remote from the market. The canned tongues of cattle, s, sheep, lambs, and swine, are extremely popular and find a sale. They are often pickled previous to canning.

POTTED MEATS

otted and "deviled" meats in great variety are an output of acking houses. The term "potted meat," is like the name of prietary food or medicine, and conveys to the customer no as to the contents of the package. The consumer is not excluded by it. Sausage may be made from the meat of neat cattle or swine and may be fresh, salted, pickled or smoked, with the addition of salt, spices, edible fats, blood or sugar. It contains no more water than does the normal meat from which it was prepared. If casings are used they must be preserved with salt only and not artificially colored.

Next in importance to the use of meat of an improper character in the way of adulteration is the use of starch or flour as a "filler." This increases the bulk and weight of the goods and prevents shrinkage when the sausage is cooked, and moreover starch is much cheaper than meat, so a greater profit can be made. In some States a product called "cereal sausage" is allowed, if it does not contain more than 2 per cent. of cereal, and if the composition is plainly marked on the package. A substitute for sausage casings known as "viscose" has been recently put on the market. It is made from mercerized wood pulp.

Varieties of Sausage

The varieties of sausage made, especially in Germany, are very numerous; more than 40 might be readily described. Among these may be mentioned pork sausage which is put into casings consisting of the intestines of cattle, sheep or swine; bologna, in which the chopped meat is put into casings, boiled, smoked and dried; polonies which are a favorite in England, and are usually put in colored skins; rothwurst, similar to the English "Black pudding," made from pork, often with the addition of blood, heart or kidney, and spices and starch, put into skins and boiled; mett wurst, made from pork, with large additions of lard and frequently beef and horse-flesh; cervelatwurst, made from the brains of pigs and horses, with the addition of pork and lard; leberwurst, made from the livers of pigs and calves, sometimes with pork and lard and occasionally the lungs and starchy matters; magenwurst, made from the stomach, skin and other parts of the pig, with blood and unsalted bacon; bratwurst, made from raw and bacon, with lemon and cumin as flavorings; erbswurst, h contains suet, bacon and pea flour, and is seasoned with ns and spices; frankfurter sausages, which are small and made raw pork well seasoned.[1]

"MINCE MEAT"

ince meat is a mixture of not less than 10 per cent. of cooked minuted meat, with chopped suet, apples, and other fruit, salt spices and with sugar, syrup and molasses, with or without gar, fresh, concentrated or fermented fruit juices or spiritous rs, according to the standard of many of the States. Meat is lways found in mince meat and corned beef is sometimes tituted for fresh meat, and evaporated or dried fruits are also in the place of fresh fruits. Boiled cider or brandy is a non addition to the mixture.

ome manufacturers put on the market a pressed mince meat h is similar to the above, except that it contains starch or as a "binder." This also increases the weight and absorbs fragments and breaking the bones into pieces. It is well to note that the smaller the pieces of meat the greater the surface exposed, and the more thoroughly the juices will be extracted. Sometimes the meat mixed with sufficient water and salt, is heated in a vessel with a tight cover, so that the pressure can be raised above that of the atmosphere, with a temperature correspondingly higher. If an ordinary vessel is used the meat should be simmered for some time, then allowed to cool, so that the excess of fat can be skimmed off. From 5 per cent. to 8 per cent. of the constituents of the meat, consisting of soluble albumin, gelatin, extractives, mineral matter and flavoring material will be found in this broth. The analysis of a large number of home-made and canned soups shows that they contain from 2 per cent. to 6 per cent. of protein, from 0.1 to 4 per cent. of fat, and from 0.2 to 8 per cent. of carbohydrates.

If the soup is intended simply for a first course, to stimulate the appetite it may be a "clear soup" or one only slightly thickened like consommé, bouillon, chicken broth, mulligatawny or ox-tail soup, but if it is to constitute an important part of the meal, its nutritive value should be increased by thickening with pea-flour, or lentil-flour, or the addition of peas, lentils, macaroni, vermicelli, egg, or vegetables cut in small pieces.

Bouillon Cubes—Soup Tablets

In making the best grades of soup tablets the meat is extracted at a low temperature, so as to avoid the coagulation of the albumins, the liquid is strained at 200° F. and, after being properly flavored and seasoned, is concentrated and poured into molds to set. Sometimes these soup tablets are made without meat, from the gelatin obtained from cartilaginous tissues such as calves' feet, and tendons, properly flavored, and colored with caramel.

According to the investigations, of F. C. Cook,[1] the bo cubes on the market contain from 49 to 72 per cent. of co from 8 to 28 per cent. of meat extract; and from 3 to 30 per of vegetable extract. In the poorer brands of cubes the nt of meat extract is very small and the quantity of common is large. These cubes are by no means, as many believe, ntrated beef or meat essence, but really stimulants or flavor-gents.

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[1] Bull. Dept. Agri., No. 27, 1913.

MEAT EXTRACT

here is upon the market a large variety of products of the extract class, such as solid extract, liquid extract, beef tea, juice, soluble meat, meat essence, yeast extract, meat powder, ne and numerous proprietary preparations.[1]

emi-solid meat extracts and fluild meat extracts are to be ded as stimulating and flavoring adjuncts only. The latter ore expensive than the former, as they contain more water requently cost as much.

nce these products first became known through the investiga- of the German chemist Liebig and their manufacture in

Hutchinson,[1] in speaking of the meat extractives says "The recent experiments of Powlaw have shown that they are the most powerful excitive of gastric secretion that we possess. They are thus eminently calculated to rouse appetite, and aid digestion of any food with which they may be taken. This is indeed their true rôle, both in health and disease."

BEEF JUICE—BEEF TEA

Beef juice is a different product from beef extract, in that it should be the juice of the *raw meat* extracted simply by pressure.

For domestic use "beef tea" can be readily prepared by allowing the finely chopped meat with a little salt to stand in cold water for half an hour, and then heating for some time in a double boiler at a temperature always below 160° F. The juice may then be poured off, and the meat pressed to remove as much additional juice as possible. When cold, the fat, if any, is removed from the top. The flocculent sediment contains most of the nutriment. The domestic beef tea prepared shortly before use is much more satisfactory than any commercial preparations. An excellent quality of home-made beef juice is prepared by slightly broiling small pieces of meat, and then expressing the juice, which should be seasoned and served while still hot. Meat juices contain the soluble and liquid proteins in an uncoagulated form, and are therefore better adapted for digestion than when coagulated by heat.

Gelatin is sometimes present in meat extracts, although the manufacturers of the best products try to avoid it as much as possible. (See p. 358.) Some of these commercial beef extracts and juices are of such a composition as to indicate that they are prepared chiefly from blood, rather than from meat juices, some are enriched by the addition of raw egg albumin, and the products, often contain an excess of common salt. Large quantities are made in the packing houses by the concentration of the liquors from the canning department, followed by the partial removal e salt. This is accomplished by the use of centrifugals ar to those used in sugar refineries (p. 108). After the excess t has been removed, the extract is further concentrated to a y solid consistency.

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[1] Foods and Dietetics, Hutchinson, p. 93.

SOLUBLE MEAT

Soluble meat" is prepared by treating the comminuted meat dilute hydrochloric acid and pepsin under pressure or with and steam. The object of this process is to begin the digesby converting the meat into proteose or peptone and to retain xtractives. Although there may be instances in which such a uct is of value in the diet, ordinarily it is better to require the tion to take place within the body, by natural methods.

DRIED OR POWDERED MEAT

owdered meat preparations under various names have been d on the market. They consist largely of albumoses rather with lime or soda for two or three weeks to dissolve out the fat. The mass is finally washed and steamed to remove the gelatin,

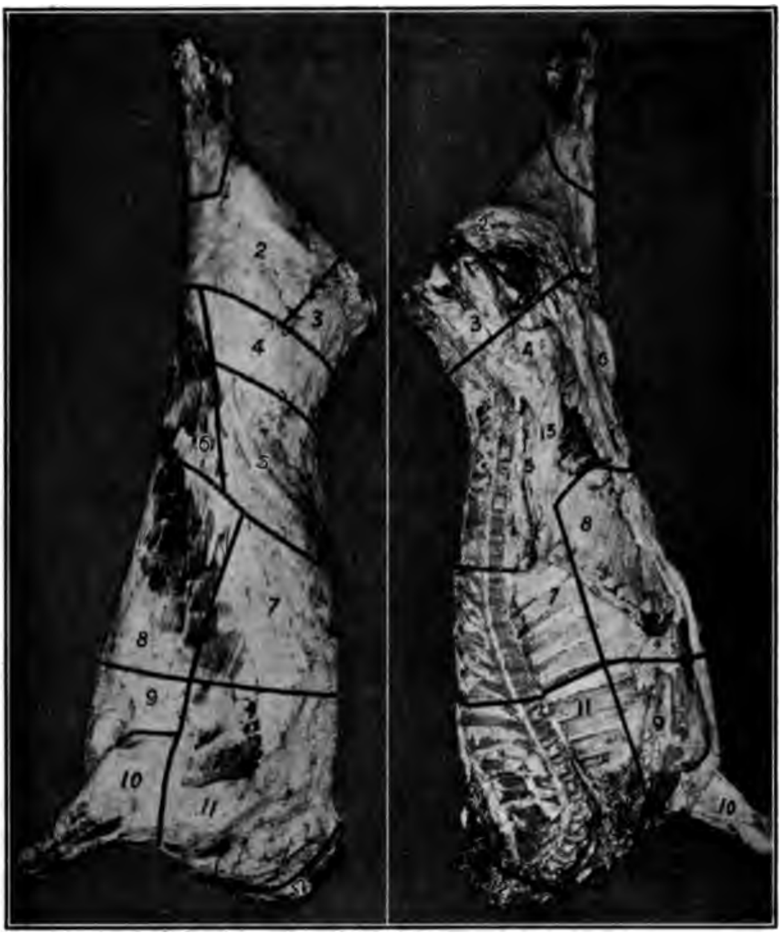


Fig. 72.—The ordinary commercial cuts of beef are as indicated in Fig. 72 and are named as follows: 1, Shank; 2, round; 3, rump; 4 and 5, loin (4, sirloin; 5, porterhouse); 6, flank; 7, rib; 8 and 9, plate (8, navel plate; 9, brisket); 10, shin; 11, chuck; 12, neck; 13, suet. (By permission Dept. of Agric. U. of Mo.)

and sulfurous acid is used in bleaching the product. It is then solidified in layers, redissolved, washed free from acids, and dried at a

mperature. If prepared under good sanitary conditions, and
material which was in the beginning fit for food, there is no
tion to the use of gelatin as a food material. - The impure,
rified gelatin is known as "glue."

elatin swells readily in cold water and as small a quantity as
er cent. will set into a jelly, although the ordinary jelly con-
about 2 per cent. It has come into popular use, because of
roperty, and because it can be sweetened and flavored, and
into numerous appetizing and decorative dishes. In re-
to its nutritive qualities some authors believe that it has a
in stimulating the flow of gastric juice, and while not a
former it has the property of sparing the protein tissues
destruction. It is evident that the nitrogen in gelatin is not
nt in a form available to the body as in true proteins.[1]

BEEF

the United States for commercial use, the carcass of beef
is usually cut as illustrated in Fig. 72.

hese different cuts, exclusive of bone, have only a slightly laxative effect, and in no way affects the health of normal individuals.

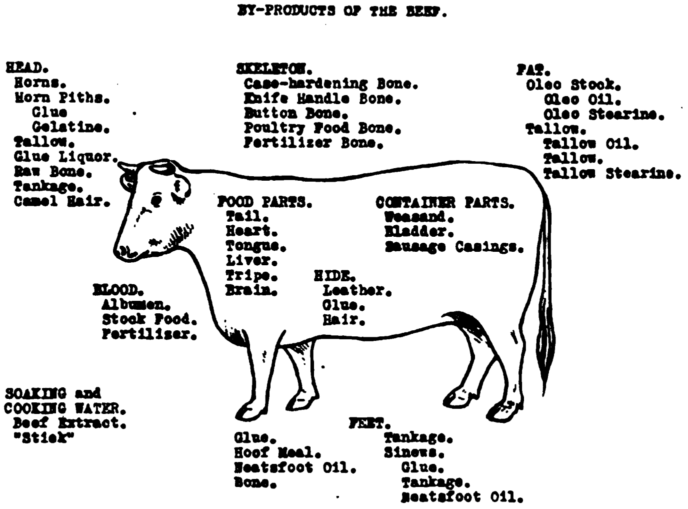


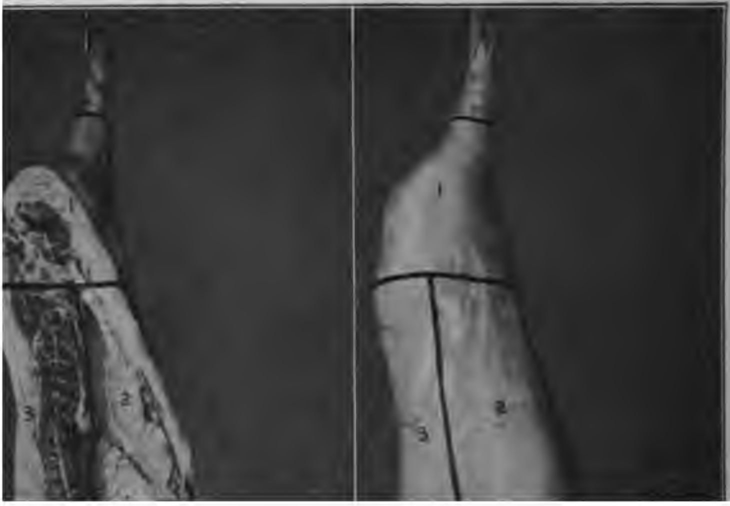
FIG. 73.—(By permission Armour Packing Co.)

PORK

Domestic swine are the descendants of the "wild boars" that formerly inhabited the forests of the Eastern Hemisphere. They are raised in great numbers in those parts of the United States where corn (maize) is readily grown, also in the South where they are fattened with peanuts and acorns and are shipped to the packing houses in Fort Worth, Chicago, Kansas City, Omaha and othes large cities.

The ordinary cuts of swine are somewhat different from those of beef, as so much of the former is utilized for salt pork and bacon. The hams and shoulders are used for pickling and smoking. From the top of the back and the belly are obtained the cuts used for salt pork. "Spare ribs," "chops" and roasting pieces are obtained below the "back cut." Leaf lard is made from the kidney fat, found inside the back. The illustration (Fig. 74) shows the common method of cutting up the hog.

lthough many believe that pork is a much less desirable food other meats, it is very extensively used by all classes of people orld over. When the hogs are raised under sanitary condi-



carry them off quickly. Pork, ham and sausage are sometimes infested with *trichina spiralis*, a parasite which may be seen encysted in the flesh. If the meat has not been carefully inspected at the time of butchering by competent veterinarians the only safety is in a thorough cooking so as to destroy the parasites. Merely boiling a ham or a large mass of meat, is not sufficient for this purpose as the interior is seldom heated to a high enough temperature. The use of raw sausages especially should be discouraged.

MUTTON

The cuts of mutton are different from those of beef and pork, and are usually six in number, three on each side of the carcass. The hind quarter of lamb is the favorite portion for roasting. The "chops" are the short ribs with adhering flesh.

By many physicians, mutton is considered the most easily digested of all the meats. Mutton fat, however, is liable to cause gastric disturbance, which may be attributed to the fact that it contains more tristeasin than beef fat, and is therefore of firmer and more compact structure, but the nutrient qualities of the two kinds of meat are the same. The best English mutton is obtained from animals six years old,[1] and in any case the animal should be three years old before it is slaughtered. The characteristic flavor of mutton is modified by cooking with a little vinegar or lemon juice, and some consider that the flavor is improved by this treatment.[2]

GOATS

The meat of goats and kids is not used extensively in the United States, although it is an important food with many European and Asiatic people. As these animals live and seem to thrive on steep rocky lands, where the amount of forage is limited, they are of great economic value for their milk, their skins and their flesh, to those who live in rough mountainous localities.

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[1] Practical Dietetics, Thompson, p. 119.

[2] U. S. Dept. Agri., Farmers' Bull. No. 526.

flesh of goats, with the exception of the angora, is not as able as that of the sheep. Goat flesh is sometimes substi- for that of the sheep in the market.

HORSE FLESH

he meat of the horse is seldom used knowingly in the United s, but forms a very important part of the diet in France, any, Austria, Russia, and Denmark. Whenever from any other varieties of meat become scarce it has in various coun- been found convenient to use horse meat.

his meat is liable to be somewhat tough and coarse, largely o doubt to the fact that horses are raised for purposes other food, and are usually old and worn out before they are htered. In the same way beef from old draught cattle or of is not nearly as good as that of the young steer which has been ally fattened to serve as food. Horse meat does not differ rially in composition from beef, except that it contains a rela- large amount (about 1.8 per cent.) of a peculiar starch called at about 102° F., the eggs are hatched as desired so as to have chickens ready for market at any time of the year.

Fowls which have been allowed to hang from one to two days are considered better for food purposes than those that are freshly slaughtered; they may of course be kept for a longer time at a low temperature as in cold storage. There has been much discussion[1] as to whether the chicken should be stored and marketed "drawn," that is with the viscera removed, or whether the intestinal organs should be allowed to remain in the fowls, but the most recent experiments show that there is no objection to the storage of undrawn poultry. A time limit should be put, by law, upon the keeping of poultry in cold storage as the quality is not as good after long storage.

By the castration of the male bird at an early age, the "*capon*" is produced and its flesh has come to be very highly prized especially in Europe, on account of its more delicate flavor.

The composition of white meat and dark meat of chicken is as follows:[2]

	Water	Water in fat-free substance	Fat	Protein	Meat bases
White meat	61.38	75.08	18.45	17.06	0.37
Dark meat	59.48	78.44	24.16	15.04	1.03

The white meat does not contain so much fat, but does contain more protein, and is better suited for the diet of invalids. The dark meat, on the other hand, contains more meat bases, consequently it has more of the characteristic flavor of the chicken. The potted chicken found on the market was formerly quite largely adulterated by the substitution of other meats.

DUCKS

The meat of the domestic duck, as well as that of the wild duck, is used for food all over the world. There are many varieties

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[1] Ill. Bull., Dept. Agri.

[2] Foods and Their Adulteration, Wiley, p. 102.

the wild geese which lived in early times in
the countries surrounding the Mediterrane
tries the goose after it is killed is allowed
several weeks before it is considered sui
Great care is exercised in fattening geese f
are given all the food that they will eat, an
from cold weather. The artificial fatte
developed in such a way that the food is a
œsophagus of the fowl by the use of a sui
dé foie gras," a favorite delicacy in parts
is prepared largely from the overgrown l
stuffed in this way so that the liver often

TURKEYS

The domestic turkey is a descendant o
plains of North America. Turkeys are
other fowls, being more subject to disease.
while young, and have the advantage of
they reach full maturity. They are often
the United States, especially late in the au

CHAPTER XV

FISH AND SHELL FISH

Since fish are abundant in both fresh and salt water, they have from the earliest times been a favorite food, indeed fish often forms the staple food of a large class of people. Many partially civilized tribes and the inhabitants of distant islands, as well as those who patronize the itinerant "fish peddler," have learned the value of fish as a cheap and wholesome source of nutriment. In fact, fish takes the place of meat to such an extent that in many countries it is used to the entire exclusion of other nitrogenous foods.

Composition of Fish

That there is considerable difference in the composition of different kinds of fish is illustrated by the analyses of a few varieties here given:[1]

Edible portion	Water	Protein N×6.25	Fat	Ash
Bass	77.7	18.6	2.8	1.2
Blue fish	78.5	19.4	1.2	1.3
Cod	82.6	16.5	0.4	1.2
Herring	72.5	19.5	7.1	1.5
Mackerel	73.4	18.7	7.1	1.2
Shad	70.6	18.8	9.5	1.3
Trout	77.8	19.2	2.1	1.2
Whitefish	69.8	22.9	6.5	1.6

The refuse in fish as purchased, which includes the head, fins, skin and bones and interior organs, amounts to from 50 to 60 per cent.

[1] U. S. Dept. Agri., Office. Ex. Sta. Bull. No. 28.

per cent. of
black fish, 2.8; menhaden, 3.9; white p
fleshed fish, 2.90.

3. Fish with less than 2 per cent. of f
0.63; haddock, 0.30; pickerel, 0.50; re
0.50; sea bass, 0.50. Fish of this latter
too coarse, are especially easy to digest.

It will be noticed from the analysis th
fish is larger than in meats. While t
value, it may tend to make fish more dig
of fish is rich in protein; sometimes rich
nitrogenous constituents also contain
"extractives" than do those of meat.
those substances that yield gelatin caus
boiling then meat, and is one reason wh
method of cooking fish. As the extracti
the attractive flavor of meat, and a fish di
monotonous.[1] The mineral constituents
phosphates of calcium and potassium,
considerable sodium chloride (commo
"fuel value" of fish, as purchased, is low
amount of

meat. As lean meat is more easily digested than fat meat, so lean fish is much less liable to cause derangement of the digestive system than fat fish. Cod fish, however, although one of the leanest of fishes, has such coarse fibers that it is not as readily digested as most fish of this class. The muscle of salted fish is hardened by the process of preservation, and consequently salt fish is not as readily digested as that which is fresh.

Because fish are less stimulating and "lighter" than meat, they constitute an excellent diet for brain-workers and those of sedentary habits. On the other hand these same qualities militate against the use of fish to entirely replace meat in the diet of the working man. It is found that fish, while it satisfies the hunger for a time, does not appease the appetite as long as does meat; the hunger soon returns.

Fish alone is not well adapted to the production of energy, but should be supplemented by bread and butter and potatoes or other starchy food. The "cod-fish" cakes" of New England, which are made from fish and potatoes, or bread crumbs, and are suually fried in pork fat, constitute a fairly well-balanced ration. In many localities fish are a cheaper source of protein than meat, and the lack of fat can be made up by serving them with a sauce of drawn butter, or by the use of some other fat-containing food. Notwithstanding the enormous quantity of fish obtained in the United States, the amount of fish imported in 1919 was valued at over $22,000,000.

Varieties of Fish

A few only of the more important fishes are here discussed. As in many cases their characteristics are so well known a detailed description is unnecessary.[1]

The **anchovy**[2] is a small fish found along the coast, in rather warm waters both in Europe and America. They are eaten pickled often as a relish more than in a fresh state. Anchovy

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[1] Foods and Their Adulteration, Wiley, 2d Ed. p. 121.

[2] American Food and Game Fishes, Jordan and Evermann.

which is found in the
5 pounds, is one of the favorite salt wa
coast.

The flesh of the **German Carp,** a fres
and lacking in taste, although it is pro
of other fish.

The **catfish** or **"bullhead"** is comm
ponds throughout the United States. S
Mississippi and its tributaries attain a
are 5 feet in length. The flesh is someti
a strong taste especially if the fish is gr
The edible portion of the catfish contain
cent. of oil, and on this account the flesh o
used in certain parts of Europe in the pla

The **codfish** of the Newfoundland B
valuable salt water fishes. Not only is i
fresh, but when dried and salted it form
of the country. The livers of the cod ar
cially in Norway, as a source of cod live
been largely propagated by the U. S. B
haddock, which is related to the cod, is a
Atlantic and

The **halibut**, which is one of the largest of the food fishes, is found in great abundance in the north Atlantic and north Pacific. Its weight sometimes reaches 500 pounds, although much smaller specimens are better for food purposes. Halibut steak is common on the markets both in Europe and America. As the flesh contains a good proportion of protein and a moderate quantity of fat, it forms a better balanced ration than codfish.

Herring, of which there are many different genera and species, are essentially salt water fish. Their habitat is especially the cool waters of the northern seas, where they grow in great abundance. Herring fisheries are found on the coast of Denmark, Norway, Belgium, France and the United States. This fish is sold either fresh or preserved by pickling, salting or smoking. "Bloaters" are dry, salted herrings afterward smoked. "Kippered" herring are soaked in brine for a short time, and then smoked over hard-wood shavings.

The **mackerel** is found in great abundance along the Atlantic coast, especially in the North, and southward to the Mediterranean and Adriatic seas. They travel in immense schools, sometimes several miles in extent. Like most other fish that are found in great abundance, they are used both fresh and salted or smoked. The flesh is comparatively rich in fat, and is therefore not as readily digested as that of some other fish. The "Tunny" or "tuna" fish is the largest of the mackerel family, and sometimes grows to the length of ten feet. The flesh is of excellent quality so it is a popular fish for canning purposes. The **pompano,** which is also related to this family, is found abundantly in the Gulf of Mexico. It is a fish weighing only 2 or 3 pounds, but its delicate flavor makes it of special value.

The Mullet is a widely distributed species, found along the Altantic coast especially off the Southern States. This fish, which sometimes reaches a length of 2 feet, is not very particular about its food, being in fact something of a scavenger, but nevertheless it is an important food fish.

The **salmon** is by many considered the most valuable of the products do not really deteriorat cold storage for more than a short perio entitled to know whether he is getting which has simply been kept on ice for a fe

Recent observations[2] have shown tha a temperature of 32° F. the activity of m ished, but the activity of ferments norma continues. While therefore meat ripens decay. With regard to fish however, alt 32° F. checks the action of micro-organis faction, the enzymes normally present i prejudicially and produce bodies of unpl although the fish has not decayed it becom

In Norway the codfish is often simply it upon poles for several months. A commo in the United States and abroad, and o extremely palatable product, is first soak smoke-drying.

In the ordinary process of curing cod States,[3] the fish, as soon as brought in by th in hogsheads with salt and allowed t

three w

The racks are so arranged that they may be covered in case of rain, and the fish are protected from the hot sun by cloth covers. The cod are then skinned and packed in various ways for the market.

"*Boned fish*," "shredded" and "desiccated" fish are also articles of commerce. The dried and salted codfish contains more than 50 per cent. of salt and frequently a little borax and this must be soaked out with water before the fish is prepared for the table. Mackerel, salmon, herring, hake, pollock, and halibut are readily and commonly preserved by the method used for codfish. Almost any of the food fishes may be preserved in brine, but those most commonly found on the market preserved in this way are mackerel, anchovies, herring, salmon and Lake whitefish.

Canning Fish

The canning of fish has developed into a great industry within a few years. As fish decomposes so readily the most careful and complete sterilization is necessary in the process. In the salmon-canning establishments along the Pacific coast the process includes

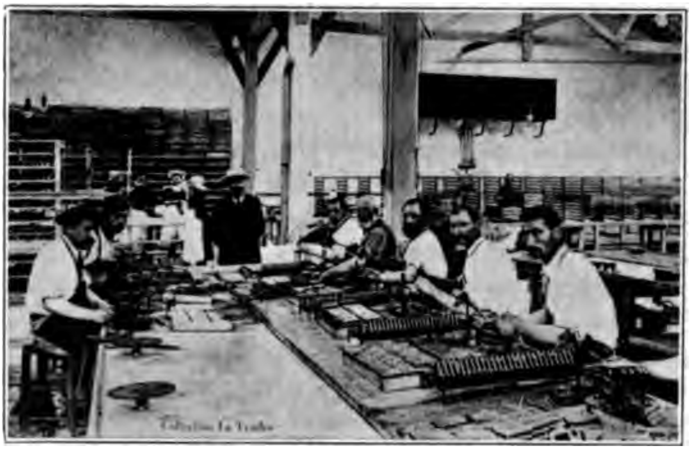

FIG. 75.—Soldering sardine boxes at Concarneau, on the French coast.

ooking is frequently pea
oil like cotton-seed or sesamé, and wl
are usually canned in olive oil, other c
adulterations of sardines are mislabel
the fish were caught, use of oils other
the substitution of other fish as sprats

Fish Product

Caviar is the preserved roe or eggs
introduced by the Moslem tribes inhabi
was so expensive that it was considered
by the wealthy. It is prepared in Russi
America. It is said that in some cases
America to Europe, where it is repacked
country to be sold at an advanced price,
The method of preparation of caviar is t
and forth over a small-meshed wire scree
the eggs drop through and the membrane
retained. Salt is then added to the egg
with the hands. After a sh
liquid dra

used as a relish or in making sandwiches. Salted *codfish tongues* are also an important fish product.

Isinglass or fish glue is prepared from the swimming bladder of various fish. The Russian isinglass is obtained from the sturgeon, while that from Brazil, the East Indies and America is usually obtained from other fish. It is used chiefly in fining or clarifying jellies and liquids such as wine and beer. *Liquid Glue*" is made from the skins of codfish, while the refuse from the drying establishments which cannot be otherwise utilized, is dried and sold as a fertilizer.

Fish oils are obtained by rendering any parts of the fish containing fat. Menhaden oil is made in large quantities along the Atlantic coast, for use as an industrial oil. Sardine oil is made especially in Japan, and along the Pacific coast and a salmon oil which may be used for edible purposes is prepared.

SHELLFISH

Under the term shellfish are included various mollusks and crustaceans that have a shell. The nutritive substances are not as high as in fish, but shellfish are used in large quantities on account of their agreeable flavor.

Oysters are grown in shallow salt waters in numerous localities throughout the temperate zone. They thrive best about the mouths of rivers where the water is brackish. In the United States they are found most abundantly on the coast of Long Island Sound, Virginia, Mississippi, Louisiana, Texas and Washington. In England they are cultivated along the coasts bordering on the English Channel. Oysters are also found at other points along the western coast of Europe, and in China and Japan. That the North American Indians used quantities of oysters is shown by the piles of oyster shells found in many places along the Atlantic coast.

A single oyster will produce a million ova in a single season. The young swim about freely for about two weeks, after which

kept in the shell for a
removed from the water, if the tempera
50°, and they are occasionally wet with
therefore, be shipped in the shell with pro
rior points.

Composition

The average composition of oysters excl
ing to Langworthy is:

Water
Nitrogenous substances
Fat
Carbohydrates
Salts

The nitrogeneous substance is probably
consists partly of nutrients of lower value
consist mainly of glycogen from the liver,
readily digested. As the amount of solid
(about the same as milk,) it is not strange t
oysters can be eaten at a meal.

The color of oysters, especially on Europe
green

and feeding them on a peculiar seaweed, which would impart a green color to their gills. There seems to be good evidence, however, to show that the green color is sometimes due to copper which has actually been absorbed by the oysters from the water in which they live. The author has found copper equivalent to 0.09 of 1 per cent. of copper sulfate in oysters.[1] J. T. Willard,[2] who has made analyses of thirty-four samples from different points along the Atlantic Coast finds that they all contained very small quantities of copper. The amount of this metal however, is probably not large enough to be injurious.

Digestibility of Oysters

Raw oysters are very digestible, and when properly cooked they are often recommended as food for invalids. They admit of a great variety of methods of cooking, and impart to the diet a pleasing variety. They are less digestible when fried, than when cooked in any other way.

Preservation of Oysters

As already stated, oysters may be kept in the shell under proper conditions for some time. There is, however, an immense market for oysters which have been removed from the shell. These were formerly shipped in the United States to interior points in tubs in which a cake of ice was floating. Aside from the fact that this method, with its frequent "icing" en route was unsanitary, the oysters under these conditions absorb a large amount of water. This is due to *osmosis*, the soluble salts of the oyster diffusing into the water, and the water entering and puffing up or "fattening" the oyster and impairing its flavor. To avoid these conditions many of the states have passed laws requiring that all oysters shipped into the state shall be sent in vessels surrounded by ice; and not with the ice in contact with the oysters. They have

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[1] Bull. Kas. State Bd. Health, 1907, p. 36.

[2] Bull. Kas. State Bd. Health, 1908, p. 4.

whence they are obtained as "Blue Poi
"Rockway" from another Long Island loc
from the New Jersey coast and "Lynhave
folk, Va.

Oysters were formerly fattened in be
sewers and typhoid fever has resulted fr
oysters which have not been cooked. T
dence that shellfish become contaminated
polluted waters, and the results of many in
these shellfish have been responsible for th
fever and other intestinal diseases. The
appear where oysters have been "floate
waters, in the vicinity of large cities.
protected in every way from all sources of
water should be proven to be pure by repea

CLAMS

The clam as a food is nearly as import
it is more commonly used along the seash
from the sea. There are two principal
[illegible]

from 2 to 4 per cent. of carbohydrates. Clams may be eaten raw, cooked, or in "chowder," but they are probably not as readily digested as oysters, because of the toughness of part of the body.

MUSSELS

Mussels are found both in salt and in fresh water. In England, Holland, and France they are more generally used than in America. The flesh of the salt water mussel is of a yellow color, and somewhat tough when cooked. The fresh water mussels are gathered in the United States for the pearls which they often furnish and there is a probability that some varieties are poisonous.

SCALLOPS

Scallops, shellfish somewhat resembling oysters, are more in favor in America than in Europe, and are obtained along the New England coast by the use of dredging boats. From September to the first of March, they are considered "in season." The muscle or hard part, used for opening and closing the shell is the part of the mollusk that is eaten.

SNAILS

Snails, especially the escargot, are much used as food in France, and Austria where they are cultivated in the vineyards in "snail nurseries." These snails are vegetable feeders, and are soft and digestible when raw, but become somewhat tough by cooking. Not less than 80 million snails are sold yearly in the *Halles Centrale*, the great market of Paris.[1]

LOBSTERS

Lobsters are abundant in the temperate zone along the European and American coast. The lobster although a salt water crustacean is quite similar to the common crawfish of the fresh

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[1] The Grocer's Encyclopedia, p. 569.

g of lobsters is an important
foundland, and along the coast of
used as food on the Pacific coast
contain less edible matter than
Bureau of fisheries is taking many
from being exterminated along the

CRAB

The flesh of the crab, both the
is highly prized especially in the
States. The "soft shell" crabs are
after shedding the old hard shell.
per cent. of solid matter, which is
flesh of the lobster. Japanese crab
food on the market.

SHRIMPS—PRAWNS—

These are all highly valued food
They are found along the coast

inclosed in a lacquered can, before the meat is processed. This precaution is taken to avoid the blackening of the flesh. Prawns are simply large shrimps, and are obtained along the Southern Atlantic coast early in the season before the smaller shrimp are plentiful.

MISCELLANEOUS ANIMAL FOODS

Turtles inhabiting both fresh and salt water, are important foods. The green turtle, which sometimes weighs several hundred pounds, is used chiefly in making soups which are greatly valued for their flavor. Turtle meat contains about 20 per cent. of protein and a small amount of fat. It is generally considered a luxury, and is rather indigestible. The flesh is cut into slices and sun-dried for preservation. The **terrapin,** a salt-marsh tortoise, is found along the North Atlantic coast. The diamond-back, and the red-bellied terrapin is in common use for edible purposes. The flesh is highly esteemed for its digestibility, and agreeable flavor. On account of the demand for terrapin, there is danger that it will be exterminated in the eastern United States, and it is already so expensive as to be classed as a luxury. The effort to raise terrapin artificially has not been wholly successful. **Frogs, legs** are a standard food in the markets of continental Europe at certain seasons of the year and are gradually being utilized in the United States. They are in the best condition in the autumn and winter. The flesh, which has an extremely delicate flavor, tastes somewhat like that of chicken, and is easily digested.

CHAPTER XVI

MILK AND DAIRY PRODUCTS

ilk, since it contains all the substances necessary to sustain
ife of the young animal, has always been regarded as an
food, and in addition to woman's milk, the natural food of
ts, the milk of the cow, goat, ass, ewe, mare, camel and rein-
have been used from the earliest times as human food. The
manufactured from milk, including butter, cheese in almost
ss variety, koumiss and other fermented beverages, have also
used by different peoples from the remote ages of the past.
r was used by the Hindus as early as 2000 B.C. both as food
n their religious ceremonies, and it is mentioned by the early
ew Greek and Roman writers It is however a product

or the alkaline reaction according as different indicators are used.[1] The specific gravity of milk varies from 1.029 to 1.035 at 60° F. This is not considered as valuable an index of the quality of milk as formerly.

It is practically impossible to obtain clean milk from cows that are kept in filthy surroundings. To obtain milk of excellent quality the cows should be housed in light, clean, warm, well-ventilated stables. In the best dairy practice the floors are of concrete, the windows are screened to keep out flies, and an abundance of good water is supplied. The udder of the cow is carefully brushed and cleaned before milking. The attendants are free from infectious disease, wear clean clothes when milking, and avoid noise and confusion in handling the cows.[2] The custom that has recently been adopted in the best dairies for marketing milk in closed bottles is an advance in sanitation. In Europe it is sold from tin or brass cans. (Fig. 76.) Milking machines are coming into general use for large dairies.

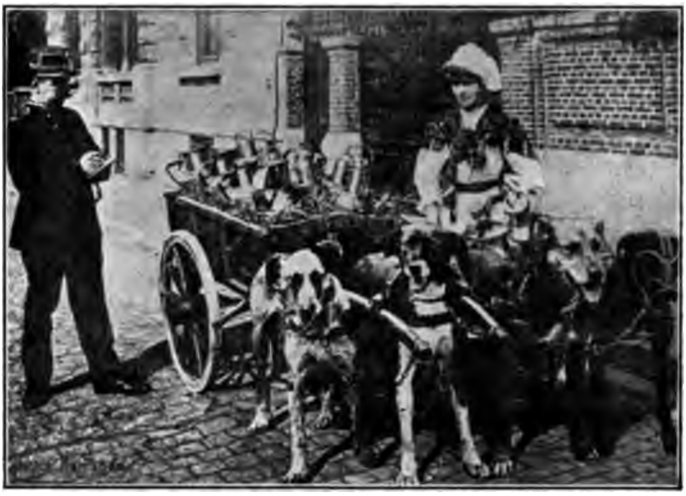

FIG. 76.—The Flemish milk seller.

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[1] Bordas, Eighth Int. Cong. Ap. Chem., Vol. 18, p. 67.

[2] U. S. Dept. of Agri. Bur. An. Ind. Circ., 142.

s milk affords an ideal medium for the growth of bacteria, it importance that the milk room, where the milk is stored, be and cool. The milk should be cooled to below 50° F. as as possible after it is drawn, and kept cold until delivered to ustomer.

Tuberculous Milk

he cows should be examined from time to time to determine her they are afflicted with tuberculosis, and any suspected al should be immediately isolated from the rest of the herd, ts milk rejected.

ays Dr. F. H. Billings: "Tubercle bacilli in milk are generally vine origin. If a dairy cow is suffering with tuberculosis there hance of the milk becoming contaminated with the bovine to which children are particularly susceptible. The bacilli entrance through lesions in the udder and through particles crement that fall into the pail in the process of milking. It een shown that cows afflicted with the disease may pass viru- bacilli with their feces, and it is probable that contamination taken to prevent this source of human disease. It must be conceded that while infected meat cannot be altogether excluded as a source of human tuberculosis, in nearly all the cases of human infection from bovine sources, the vehicle is milk or milk products."[1]

In many parts of the country, regular inspections of the dairies are made by competent veterinarians, under the direction of the state or the municipal health authorities.

Abnormal Milk

The secretion from the udders of cows and other mammals for some days after the birth of the young acts as a purgative and has a pungent taste. It is called "colostrum," and is not considered fit for human food. It contains less water and sugar than normal milk and much more albumin and ash. The amount of fat is extremely variable and it contains small organized bodies which are generally regarded as the débris of the cell structure of the gland. The milk secreted for some weeks before the calf is born is also usually rejected.

Composition of Milk

The composition of the milk of different animals is as follows:[2]

	Spec. Grav.	Water	Casein	Albumun	Total proteins	Fat	Milk sugar	Ash
Cow's	1.0315	87.17	3.02	0.53	3.55	3.64	4.88	0.71
Human	1.0290	87.41	1.03	1.26	2.29	3.78	6.21	0.31
Goat's	1.0305	85.71	3.20	1.09	4.29	4.78	4.46	0.76
Sheep's	1.0341	80.81	4.97	1.55	6.52	6.86	4.91	0.89
Mare's	1.0347	90.78	1.24	0.75	1.99	1.21	5.67	0.35
Ass's	1.0360	89.64	0.67	1.55	2.22	1.64	5.99	0.51

It is evident that milk, although a liquid, contains less water than some vegetables and fruits, for instance asparagus, which ns 94 per cent. of water; tomatoes 94.3 per cent.; strawberries er cent.; and watermelon 92.4 per cent.

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[1] Milk and the Public Health, Savage, p. 321.

[2] König.

milk the soluble substances are milk sugar (lactose), soluble in and mineral salts especially phosphates of calcium, etc., the material in less complete solution is a part of the casein, e fat globules held in suspension in the serum. Milk sugar xcellent food substance and may be obtained as a by-prod- m whey in the manufacture of cheese. (See p. 426.)

Changes in Milk

e first change that takes place in the milk on standing is the tion of the fat as cream, which rises more readily when ilk is kept at a low temperature. The second change that lk undergoes is souring which is accelerated by warm weather storing the milk in unclean vessels, or in filthy surroundings. hange is brought about by the *bacterium acidi lacti* and other ia of the lactic acid group, which aid in the formation of acid ($C_3H_6O_3$) from the milk sugar (lactose) ($C_{12}H_{22}O_{11}+$

are some persons, however, who do not readily digest milk, and they should refrain as much as possible from using it. Great emphasis has recently been placed on the importance of using an abundance of milk in the diet.")[1]

Certified Milk

Certified milk is a product which has been drawn from "tested" cows, and handled and marketed in a particular manner as prescribed by the proper authorities of the community where it is sold. In a few states only have laws been passed *defining* "certified milk," and except in these states the term "certified," as ordinarily used, means nothing, as it may be certified by interested parties. The regulations of the Milk Commission of the Medical Society of the county of New York require that there shall be less than 30,000 germs of all kinds per cubic centimeter in certified milk. It must contain on the average 4 per cent. of butter fat, and must be sold on the day in which it reaches New York City. Those dealers who furnish milk that is in every way up to the standard are entitled to use caps on their jars stamped by the city as certified by the Milk Commission. It is the duty of the official inspector to see that there are no tuberculous or diseased cows in the herd, that the stables are clean, that the milk is drawn in sanitary surroundings, by clean employees, and that it is, as far as possible, free from bacteria. Certified milk is often found containing only 8000 bacteria per cubic centimeter, while an ordinary market milk may contain as many as 300,000 or more.

Pasteurized Milk

The *boiling of milk*[2] produces the partial fixation of the calcium salts, probably precipitated as tri-calcium phosphate, and the precipitation of magnesium salts. About one-third of the citric acid is precipitated as tri-calcium citrate, and the soluble albumins are entirely precipitated.

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[1] The Newer Knowledge of Nutrition, McCollum, p. 76.

[2] Morse, J. A. M. A. Vol. 60, p. 876.

steurized milk is a product which has been heated for some whereby the activity of the bacteria is very much diminished nany of the non-spore-bearing bacteria are killed. Milk an unknown source should always be pasteurized before given to children. Two processes are in common use. "holder" process which is most in favor the milk is held at F. for thirty minutes. In the "flash" process the milk is ally heated to 160° F., held at this temperature from thirty ds to one minute and then quickly cooled. Milk may be niently pasteurized in the home[1] by setting the bottles ich the milk is delivered into a tin pail upon a false bottom oden slats or an inverted pie tin in which some holes have punched, filling the pail with water, nearly to the level milk, and placing it on the stove or over a gas flame. Punc- he pasteboard cap of one of the bottles and insert a thermom- An instrument provided with a scale etched on the glass is est form to use. Heat the milk until the mercury stands 150° F., but below 155° F., then remove from the stove, and upon the market. Although numerous patents were granted, earlier yet the first commercially successful plant for making condensed milk in the United States, was erected by Gail Borden in 1856 at Wolcottville, Conn. The value of the condensed milk made in a single year is over $33,000,000, and this amount is rapidly increasing. An American, Chas. Page, introduced the process into Switzerland in 1867, and was the first to build a factory there. Milk preserved in this way is an extremely convenient addition to the diet in the army, on shipboard, and for the traveler, where fresh milk is not obtainable. It is concentrated and canned either with or without the addition of cane sugar.

Condensed milk is most readily prepared by boiling the milk in a vacuum pan to the required density, and then sealing immediately in tin cans. It should contain not less than 20 per cent. of milk solids. In the United States, before the enforcement of the "Pure Food laws," there were in the market many brands of "so-called" condensed "cream" or evaporated "cream" that were in reality only concentrated milk. Skim milk was often concentrated and sold as evaporated whole milk. At present the label on the can must correctly describe the contents.

25,720,000 cases of evaporated milk, and 13,441,000 cases of condensed milk was made in 1919.

A comparison of the percentage composition of the sweetened and unsweetened condensed milk is as follows.[1]

	Total solids	Water	Milk solids	Cane sugar	Milk sugar	Proteins	Fat	Ash	Fat in original milk
Normal sweetened cond. milk	74.29	25.71	32.37	41.92	11.97	8.46	10.65	1.29	4.56
Normal unsweetened cond. milk	28.16	64.24	......	2.2	9.85	8.66	8.10	1.55	3.68

Diluted condensed milk is sometimes used as food for infants. It is by no means a perfect food, but it has the advantage of being rom bacterial contamination, and in some circumstances is than raw cow's milk. This is particularly the case when ling, or living in the city where milk that is known to be of quality cannot be obtained.

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[1] Food Inspection and Analysis, Leach, 4th Ed., p. 196–197.

Desiccated Milk (Milk Powder)

pecial processes have been invented for evaporating milk *dry powder*. One of these consists of feeding the milk in n sheet on to a pair of steam-heated cylinders revolving in site directions, and having a surface temperature of about F. (100° C). The milk is dried in about thirty seconds, and aped from the roll by a knife edge. By another process the in the form of a spray is forced into a hot air chamber while r current drives the dry particles against a screen which ts the solid portions and allows the air to pass on.

he greatest difficulty in the manufacture of desiccated milks separator. It still contains the valuable proteins, a little fat, the milk sugar, and most of the mineral salts. Skim milk should be sold under its true name and should not be used as an adulterant for whole milk.

Modified Milk

As may be seen from the analysis on page 387, human milk is not as rich in solids as cow's milk, and although it contains about the same amount of fat, there is more sugar and less protein. Over 50 per cent. of the protein in human milk is in the form of albumins, while in cow's milk only one-fifth is in that form the remainder being in a state probably less digestible. Cow's milk has also a tendency to curdle into tough masses in the human stomach, and this material is not as readily digested as a similar product when coagulated from human milk. Furthermore, the fat globules are much smaller in human milk than in cow's milk.[1] There are, therefore, many points of difference between the two kinds of milk, and in infant-feeding especially an effort is made to imitate human milk by "*modifying*" cow's milk. The ingredients usually employed for this purpose are cream, containing 16 per cent. of butter fat, skimmed milk (from the separator) milk sugar, and sometimes lime- or barley-water. These should always be mixed according to a formula prescribed by a physician, or by a competent nurse. The proportion of each ingredient to be used varies with the age of the infant. As cream is generally rich in bacteria, infants often thrive better if it is not added in preparing modified milk. In modifying milk, the general method is to bring the proteins and ash to the right proportion by dilution with water, to add lactose to increase the sugar, and finally cream to increase the per cent. of fat.

ADULTERATION

Milk is *adulterated* in various ways, usually by

1. *Addition of water.*

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[1] Human Foods, Snyder, p. 89.

2. *Removal of cream with or without addition of water.*
3. *Addition of preservatives.*

detecting the addition of water the lactometer, an instru-
for determining the specific gravity of milk, which sinks
definite point in pure milk of a specified temperature, is
. If however, fat is removed thus raising the specific gravity,
t the same time water is added, which lowers the specific
y, these two operations may be so combined as to produce a
e of milk that will nearly correspond in specific gravity to
milk, although of course adulterated. Before being assured
the purity of the sample it is necessary to determine the
nt of fat and the "solids not fat."

ne per cent. of fat can be obtained by the use of the "Bab-
tester, a simple instrument devised by Prof. Babcock of
nsin. To use this instrument, 17.6 c.c. of milk are placed
ottle which has a long neck graduated in such a way that the
ers represent per cent. of fat. 17.5 c.c. of *commercial* sul-
acid (1.82 sp. gr.) is then added to the milk and the bottle is

in Minnesota. In case there is a disagreement as to the amount of fat in a sample of milk, it is best to draw the milk directly from the cow, and have it tested. In this connection it should be noted, however, that the first milk drawn from the udder is not as rich in fat as the last milk or the "strippings" as it is called, and so in order to get a fair sample *all the milk* should be drawn and well mixed before being tested.

It appears to be a fact that milk is secreted against a constant osmotic pressure in the udder and therefore its freezing point varies over a very narrow range. Use of this fact was first officially recognized in Australia, and recently Dr. J. Hortvet of Minn. has assembled a compact apparatus for testing the freezing point of milk which make this the most simple and reliable method we now have for detecting adulteration.

The Use of Preservatives

In order to prevent the souring of milk various chemicals have been added to it. Formerly sodium bicarbonate (baking soda) was used for this purpose as it would neutralize the lactic acid as fast as it was formed. More recently the milk has been preserved by the use of boric acid, hydrogen peroxide or formalin. The use of preservatives is forbidden by law in most of the cities and states of the United States. Although there is a difference of opinion on the exact action of different preservatives and the extent to which they interfere with the process of digestion, when administered with the food, yet nutritive material that is of such importance, and is frequently the sole dependence for nourishment for infants and invalids, should be kept absolutely free from adulteration.

Poisonous Milk

Although milk affords an excellent medium for the growth of germs, most of those found in it are not injurious to the system. There are, however, certain bacteria which find their way into milk red in dirty, damp unsanitary surroundings, which produce mely poisonous products. These are sometimes found also eese and ice cream and if taken into the system, produce dangerous and sometimes fatal results.

Fermented Milks

oumiss is an alcoholic beverage made originally in Asia r by fermentation of mare's milk, which it has been noticed, her in sugar than cow's milk. This beverage contains from per cent. of alcohol, and less than 1 per cent. of lactic acid, the casein is somewhat modified during the process of fer- ation.

ephir (or Keffir) is a drink prepared especially in the Cau- , by the fermentation of cow's milk using a fungus known as ir grains. It usually contains less than 1 per cent., though ionally nearly 2 per cent. of alcohol.[1]

double fermentation takes place during the manufacture of

In the United States and Europe an imitation koumiss is made by fermenting cow's milk with yeast at a low temperature, often after the addition of cane sugar. The beverage should be kept in the same bottles in which it is made and these should be stored with the necks down. Care should be taken to see that the corks are tied in securely, and during the first day or two it is advisable to shake occasionally.

A number of different kinds of so-called Bulgarian Milk Bacilli have been introduced on the market. These are in tablets, powders, or in a semi-liquid form. By the use of these, added to sterilized or pasteurized milk, under right conditions of temperature, an excellent so called "buttermilk," which is both palatable and a valuable nutrient for dietetic purposes is obtained.

Yoghoort[1] (or Jauert lactic acid bacteria) which is found in the market as a material for making a milk beverage, consists of three bacteria, viz., Bacillus Bulgaricus, which produces most of the lactic acid and works in milk up to 2 1/2 per cent. of this acid, a lactic acid streptococcus, and Bacteria lactii acid, Güntheri. Sometimes the Bacillus Bulgaricus is mixed with the Glucobacteria, in order to produce a sugar from starch in the intestines as food for the growth of the Bacillus Bulgaricus. Skimmed milk is boiled or pasteurized, cooled and innoculated with these bacteria, and allowed to stand for some time in a warm place to facilitate their growth. It is then cooled and will keep for some time on ice. The theory has been advanced that the great age attained by some of the Bulgarian peasants is due to the continued use of sour milk products.[2] **Matzoon** is another milk preparation, introduced from Armenia. It appears to have been produced by the lactic fermentation of milk enriched with cream.[3] **Leben** is an Egyptian and Arabian product made from the milk of the buffalo, camel, cow or goat.[4] **Dadhi** is a similar preparation made in India.

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[1] Hügo Kühl, (Abst.) C. A., Vol. 6, p. 2797.
[2] The Prolongation of Life, Metchnikoff.
[3] Dairy Chemistry, Richmond, p. 244.
[4] Nat. Geog. Mag., Vol. 26, p. 567.

MILK PRODUCTS COMPARED

omparing some milk products, it has been found that the fuel [1] is as follows:

	Calories Per Pound
Whole milk	310
Skim milk	165
Buttermilk	160
Cream	865
Unsweetened cond. milk	780

e estimation of the fuel value is the best way of determining elative nutritive value of foods, these figures show, other s being equal, how valuable these products are as food. They also to emphasize the fact that skim milk and buttermilk so much nutritive value, that they should not be ignored as ble additions to human food.

Homogenized Milk

n apparatus known as a "homogenizer," which has the faculty before any other, but this is probably the result of habit and acquired taste. In many foreign countries the people who have become accustomed to the milk of other animals find it just as satisfactory as we do that of the cow. Goat's milk is in very common use, especially in the mountainous districts of Europe. In Italy it is no unusual sight to see the milk "peddled" through the streets of the cities, by driving the goats to the door, and milking in the presence of the customer. (Fig. 77). There is quite a difference of opinion among physicians as to whether there is any advantage in using goat's milk in the place of cow's milk for feeding infants.

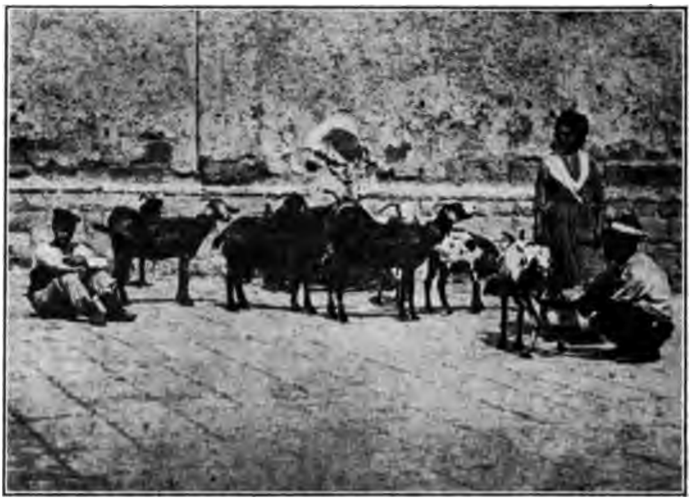

FIG. 77.—Selling goat's milk, Italy.

According to recent statistics there are upward of 3,500,000 goats in Spain.[1] These are driven through the streets for milking during the early morning and afternoon hours. Only a small portion of the milk produced is made into cheese. The goat weighs from 55 to 96 pounds, and the daily average of milk given is a little over two quarts per goat. The cost of food consumed, h consists of dried alfalfa and beans, is about 9 cents a day. milk is more commonly used in Spain than is cow's milk.

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[1] Daily Consular and Trade report, No. 283. 1913.

'he milk of the water buffalo is used in India, and that of the a in South America, while camel's milk is a staple food on the ts of Arabia, and mare's milk on the steppes of Russia and al Asia. The milk of the sheep is used in parts of Europe in us ways, including the making of cheese; reindeer milk is ple food in the arctic regions. The milk of the carabao or buffalo is in common use in the Philippines.

many countries, milk forms a very important part of the supply for adults as well as children, and much more is used apita than can be economically raised under the special tions of climate, altitude, feed, and environment of that ty.

CREAM

'hen milk is allowed to stand for some hours in a cool place, at about 60° F., in shallow pans, the fat globules and some rator." The introduction of this type of machine opened a new epoch in the methods of butter-making. Since the first mechanical separator was patented many improvements have been made. The instrument consists essentially of an upright bowl turning on a perpendicular axis at a rate of from 5000 to 8000 revolutions per minute. When the milk is run into the machine, the centrifugal force, acting more strongly on the heaviest parts of the milk, throws them to the periphery of the bowl, and here the skim milk is drawn off, while the lighter part of the milk (the cream) remains closer to the center and is discharged through its proper pipe. The rate of inflow can be regulated so that the apparatus will deliver cream of any desired degree of richness. A good separator will leave only one-tenth of 1 per cent. of fat in the skimmed milk. The capacity of the larger machines is from 1000 to 2000 pounds of milk per hour.

Composition of Cream

Commercial cream contains from 18 to 25 per cent. of butter fat. The standard of the Fed. I. Dec. is 18 per cent., but different standards have been made in the different states. It would be well if more attention was paid to the quality of cream furnished for domestic use. Its butter fat content should be just as carefully watched as that of milk. Cream obtained by the use of the separator can be made much richer than gravity cream, and will keep longer, as it does not contain so much of the entangled casein. In addition to adulterations by the use of preservatives and the addition of milk, gelatin and calcium saccharate have been used to increase the consistency of a low-grade cream. "Whipping cream" should contain at least 30 per cent. of butter fat.

ICE CREAM

The manufacture of ice cream is largely a development of the nineteenth century, especially in the United States. The first advertisement of ice cream appeared in a New York paper, June 8, 1786, but the wholesale business was not originated until after 1800. The present annual output is over 120,000,000 gallons.

cording to the U. S. Standard, "ice cream is a frozen product from cream and sugar, with or without flavoring, and con- not less than 14 per cent. of milk fat. A fruit or a nut ice may contain not less than 12 per cent. of milk fat." The ry method of freezing is to place the material in a vessel in it can be mechanically stirred, and surround this vessel with d ice and salt. The temperature produced by this mixture . which is so much below 32° F., the freezing point of water, he interior mass is quickly congealed. In large ice cream ies, where the brine surrounding the cream is cooled by liquid nia as in the commercial ice plant, the process of ice-cream g is continuous, and the frozen mass is continually delivered the machine.

evious to the enactment of the Food and Drugs Act of 1906 ses of the so-called ice cream on the market, showed that some contained 20 per cent. of milk fat, much of it con- l less than 10 per cent. and not a little was actually poorer in an normal milk, for it contained less than 3 per cent.

genized," that is by the use of a suitable apparatus the cream is subjected to a pressure of from 3000 to 5000 pounds per square inch and is thus made homogenous throughout. The use of this product enables the ice cream manufacturer to make cream having the body and texture of a 20 to 25 per cent. article, from a cream containing only 16 or 17 per cent. of butter fat.[1] (See p. 398.)

Ice cream is flavored by the use of extract of lemon or vanilla, and with chocolate, cocoanut, coffee, fruits, nuts and berries. Genuine fruits and berries either fresh or preserved, impart a delicious flavor to the product, but cream which is artificially colored with aniline dyes, and flavored with synthetic extracts should be avoided. Ice creams have been found on the market in which a part of the milk fat had been replaced by cheaper animal or vegetable fats. It should not be forgotten that ice cream, has a high fuel value and is not simply an agreeable dessert product.

The use of ice cream in the United States is constantly increasing. The manufacture of these products has never been so far perfected in Great Britain or on the Continent, as in the United States, nor have the people learned to use them so extensively.

BUTTER

When cream is designed for the manufacture of butter a "ripening" process is required before it is suitable for making a good quality of butter. No special precautions are required when the shallow pan or deep-setting system of raising cream are used, as these processes require considerable time and the cream has time to ripen, but with the employment of the separator, the cream must stand for several hours to become fully ripened.

Ripening Cream

For the ripening of separator cream, its temperature is reduced to at least 50° F. for a time, and the process is completed at a temperature of 60° F. to 70° F. It is during the process of ing that the characteristic and agreeable flavors that so fy the quality of the butter[1] are developed. In the ordinary , this ripening is due to the production of lactic acid through gency of the lactic ferment. The presence of the germs bring about this fermentation in the cream may be left ance inoculation or they may be added to the cream. If ms desirable to add the germs of fermentation, this may one by adding some buttermilk or cream, or an artificial ter" of soured skimmed milk, or some commercial lac- rment may be used. It is important that only the desir- erms should find their way into the milk, for there are both l" bacteria and "bad" bacteria.

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[1] Milk and Its Products, Wing, Revised Ed.

he use of commercial bacterial ferments was originally prac- in Sweden and Germany, and has now become quite common st-class dairies abroad. In the United States, through the s of the Agricultural Experiment Stations of Connecticut, igan and other states, the use of improved cultures has been ded, and the amount of butter produced with the "June led naturally to the churning of the milk in a goat or sheep skin, by rocking it on the knees, a process that is still used in the Pyrenees.[1] The proper temperature for churning depends on many factors, but in general is between 50° F. and 66° F., and should be as low as possible compatible with the butter "coming" in a reasonable time.

Working the Butter

After the butter is "gathered" in the churn and the buttermilk is drawn off, the butter should be washed several times with cold water, and then taken out and "worked" to remove as much of the water as possible, as the presence of this dilute buttermilk interferes with the keeping qualities of the butter. After the butter is worked, salt is usually incorporated in the product, to improve the flavor and to slightly assist in its preservation. As salt is cheaper than butter, some manufacturers add it in excess. On the Continent of Europe, salt is hardly ever used, and the butter is purchased every day for immediate consumption. A person who uses unsalted butter for a time, soon ceases to notice the absence of salt in the product. Butter for immediate consumption is put up into cakes or prints by being pressed into a mold. These are of standard weights as 1/2 pound, 1 pound, etc. Considerable difficulty was for a time experienced in some states because the butter factories persisted in putting short weight packages on the market, and even went so far as to claim that these were not sold as standard weights, but only as "cartons" or "packages."

Packing

Butter may also be packed with salt and a little sugar[2] in a tub or crock, and kept for some time or shipped to a distant market. In some parts of Europe it is a common practice to heat butter to boiling, and keep it hot until the water has been expelled, then it through cloth to remove any casein, into earthen-ware jars. is process, butter made in the summer is preserved for use winter, but the flavor and texture of the butter are in- Boric acid and borax are sometimes used, especially on ontinent to preserve butter for export.

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[1] The Bacillus of Long Life, Douglas, p. 9.

[2] Church, Food, p. 154.

Composition of Butter

recent bulletin[1] gives the following as the average com- on of creamery butter from eight of the most important states, and this fairly represents the butter on the market y in the United States. Average of 645 samples: fat 82.31; 13.92; salt 2.62; curd 1.14. By the most recent Federal butter must contain not less than 82 per cent. of butter fat.

Composition of Butter Fat

sidered legitimate. The standard of the U. S. Department of Agriculture, allows "less than 16 per cent." of water and a larger proportion is regarded as adulteration.

Coloring Butter

The butter churned from the milk of cows fed on dry rations, the usual feed in winter, is very light in color. To make this winter product look like "June" butter, and perhaps to make it more appetizing, it is a very common practice to color it. Annatto, a yellow coloring matter from the seed of the *Bixa orellana*, and occasionally aniline dyes are used for this purpose. Since the artificial color is used to make a winter butter "appear better than it really is," although it is allowed by law, many condemn absolutely the practice of coloring butter.

Dietetic Value

It has been suggested that one reason why butter is so readily digested and absorbed[1] is that the melting point of the fat is low as compared with that of many of the other animal fats. Because it is one of the most easily digested of the animal foods, butter is of great value as a source of fat in the treatment of invalids. In such diseases as phthisis, diabetes and some forms of dyspepsia. patients can take as much as one-fourth of a pound a day without difficulty. Butter which has been heated, as in cooking, is, however, not so wholesome as that which is raw. It has been shown that the absorption of butter through the intestines is almost complete, so that even when large quantities are eaten less than five-tenths of 1 per cent. is wasted.

In India and some parts of Europe, a substance called "ghee" is prepared from the cow or buffalo butter by melting it and allowing it to cool, then pouring off the more liquid portion, which constitutes the "ghee." This is used in a semi-fluid condition for cooking and in the preparation of many kinds of food.

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[1] Food and Dietetics, Hutchinson, p 131.

though butter is an exceedingly valuable addition to the ration, it is not a cheap form in which to obtain heat and y. Its special dietetic value is discussed on p. 25 under ines.

BUTTERMILK

ttermilk differs from milk in containing very little fat. It ich in protein (casein) as milk, and since this is in a finely d condition, it is quite readily digested. Buttermilk ins nearly as much milk sugar as the original milk, for the ue to the lactic fermentation is very small. On account of esence of the lactic acid, buttermilk is an excellent diet in eatment of certain diseases.

ARGARINE, OLEOMARGARINE AND BUTTER SUBSTITUTES

nce butter is expensive, various cheaper substitutes have the kettle. The liquid fat is drawn off and allowed to become practically cold when it sets to a thin semi-solid. (Fig. 79.) This viscous fat is then wrapped in cloths and transferred to a powerful screw or hydraulic press, where the liquid oil is separated from the solid fat by heavy pressure. (Fig. 80.) The solid position known in the trade as "oleo-stearine" finds many uses in the arts, particularly in the manufacture of "lard substitute."

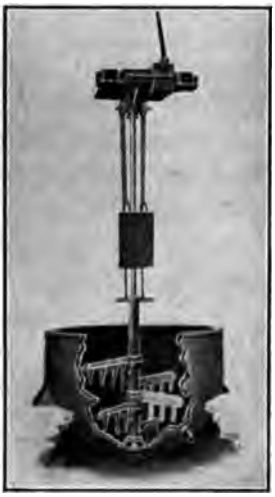


FIG. 78.—Kettle for oleo stock.

The oleo-oil, as used in the manufacture of butter substitutes, is a clear amber-colored fluid, and when fresh is free from any disagreeable odor or taste. It consists of a mixture of olein and palmatin. (See p. 308.)

"Neutral" is made by melting leaf lard and allowing it to "grain" by standing for some time at a temperature favorable for the crystallization of the stearine in coarse grains.

In the further process of manufacture of the oleomargarine, the oleo-oil, neutral, and usually cotton-seed, peanut or sesame oils, are mixed with the required quantities of milk, cream or butter, with or without coloring matter. The product is then

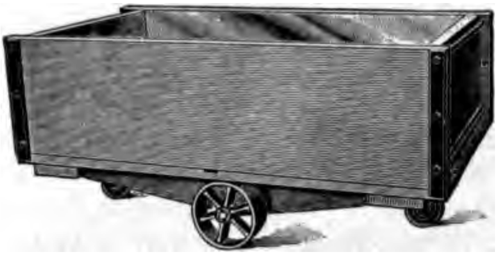
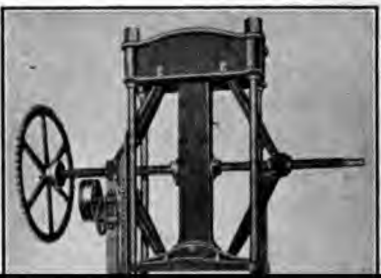


FIG. 79.—Oleo-seeding truck, in which olein separates from stearin.

d by contact with ice water, drained, worked, salted and
d in much the same manner as genuine butter.

he composition of commercial oleomargarine[1] is: Oleo-oil,
20 to 25 per cent.; butter from 10 to 25 per cent.; neutral
0 to 45 per cent.; and milk, cream, salt, etc., from 5 to 30
nt.

vestigations (especially that of the Massachusetts State
of Health (1887)), which were made in regard to the



there is every reason to wish that the prejudice against it, which is still rather widespread, should quickly disappear, and that it should be welcomed as an admirable and cheap substitute for a rather expensive but necessary food." Oleomargarine should, however, be sold on its merits and not under the name of butter, and there is no reason why it should not be sold considerably cheaper than the latter. It is also worthy of note that oleomargarine is manufactured under strict government supervision, and only pure, clean materials are allowed to enter into its composition.

Oleomargarine Legislation

There has been a tendency, to adulterate butter with oleomargarine, and to sell it for dairy butter. On this account, and in order to protect the dairy interests, much legislation in different countries has been directed against it. Sometimes this has been so severe as to be almost prohibitory. The Federal law, and most state laws, require that oleomargarine be labeled in such a way that the consumer may know what he is purchasing. In 1886 the United States Congress passed a law imposing a revenue tax of one-fourth of a cent per pound on all oleomargarine, and special taxes on manufacturers and dealers. If the product is colored in imitation of butter it must pay a tax of 10 cents per pound. Peanut oil and sesamé oil, as stated above, are common constituents of margarine. In Germany the law requires that margarine shall contain 10 per cent. of the latter oil, to facilitate the detection of the fraud, if margarine is used as an adulterant of butter. In Great Britain, it is illegal for "margarine" to contain over 10 per cent. of butter, or over 16 per cent. of water. By the use of various fatty acids, especially butyric acid and its esters, and such substances as coumarin, the flavor of genuine butter is sometimes imitated in this product both in the United States and in Great Britain.[1] Large quantities of margarine are used all over Europe, on account of the high price of butter. The people of

[1] Foods, Their Origin, Composition and Manufacture, Tibbles, p. 350.

rk, although themselves among the largest producers of , are very large consumers of margarine. Besides the t of oleomargarine, oleo oil and imitation butter consumed in untry, we exported in 1919 23,000,000 pounds to foreign ies. Although formerly an excess of animal fat was t the present time 70 per cent. of the fat is of vegetable 1

RENOVATED BUTTER

vated or process butter is made by melting old, rancid, ble butter at a temperature of about 112° F. in a tank sur-d by a water jacket and while hot, drawing off the curd and t the bottom and the scum from the top. Air is then blown h the mass for some time to remove the disagreeable odors vors as much as possible, after which it is quickly cooled. ass is then churned with some new milk, which may con-ltures of various "good" bacteria to develop a satisfactory was very early used by the nomadic tribes of Asia and Africa. The fact that it is "storage food" containing much nutriment in a small space, would commend it to those without a fixed habitation.

The property of coagulation which milk possesses, would naturally be utilized by various peoples, very early in their racial history. This coagulation may be brought about naturally by the bacterium acidi lacticus and other organisms, which find in the milk, their natural medium for propagation, or it may be induced artificially by the use of an acid or of "rennet," which is a soluble ferment found in the fourth stomach of the calf. By whatever process the coagulation is produced, the casein of the milk, called the curd, which also entangles considerable fat, is precipitated, and the whey, which contains some nitrogenous matter in the form of albumin and lacto-protein and the milk sugar, remains as a thin acid liquid.

Cheese Making

In the ordinary process of cheese making as used in the United States the casein is coagulated by the addition of rennet to milk, held at a temperature of about 41° C. (106° F.). Sometimes a yellow coloring matter such as annatto or an aniline dye is added to the contents of the vat. Milk must be ripened before the rennet will act, which means that a certain amount of lactic acid is desirable, and this acid also assists in the ripening of the cheese. Sometimes a "starter" of previously ripened milk or sour milk is used to hasten this ripening. The batch while still warm is then beaten with a mechanical stirrer for the purpose of breaking into smaller pieces the chunks of curd, and then transferred to cloths, often contained in molds and the whey squeezed out in a press. When the cheese has become solid, it is removed from the mold, and stored in well-aired rooms to allow the flavor to develop under the action of bacteria. During the process of ripening, which greatly improves the flavor, there is also an increased solubility proteins, and the formation of a small amount of amid and tic compounds. The cheese during this process is daily l and rubbed with oil.

has been asserted that the *fat test* is not a good basis upon to purchase milk for cheese factories, as the cheese-making depends on the amount of casein, but it has been shown[1] that which is high in fat is also, as a rule, high in casein. The ed product, water free, must contain at least 50 per cent of fat, according to the U. S. Dept. of Agric.

Use of Rennet

ennet, the enzyme which causes the separation of the curd hey, is exceedingly active as in cheese making only one part nmercial rennet is used with 10,000 parts of milk, yet it acts by contact, and is not itself affected. It is said that one part *pure* enzyme will coagulate three million parts of milk.[2] et[3] is most active at the temperature of the body (98° F.). 80° the action is slower, and above 100°, although the action

Composition of Cheese

The average fresh cheese contains about the same ratio o protein and fat as are found in milk. More than one-fourth i protein and one-third is fat.[1] For purposes of comparison th following table gives the composition of some of the more commo varieties of cheese:

	Water	Casein	Fat	Sugar	Ash
Cheddar	34.38	26.38	32.71	2.95	3.58
Cheshire	32.59	32.51	26.06	4.53	4.31
Stilton	30.35	28.85	35.39	1.59	3.83
Brie	50.35	17.18	25.12	1.94	5.41
Neufchâtel	44.47	14.60	33.70	4.24	2.99
Roquefort	31.20	27.63	33.16	2.00	6.01
Edam	36.38	24.06	30.26	4.60	4.90
Swiss	35.80	24.44	37.40	....	2.36
Full cream (average)	38.60	25.35	30.25	2.03	4.07

The cheeses, omitting a few of less importance, are divided b Tibbles,[2] into the following classes:

I. **Soft cheeses:**
  (a) English, cottage, cream and some local varieties.
  (b) Foreign, Bondon, Brie, Camembert, Limburger, Neufchâtel, Pont l'Evêque, Gervais, Strachino.

II. **Hard cheeses:**
  (a) English:
    1. Stilton type.
    2. Cheddar type.
  (b) Foreign: American Cheddar, Gouda, Gruyère, Emmenthaler, Edam, Gorgonzola, Parmesan, Roquefort Sap Sago, Cacio-Cavallo, Port du Salut. (Fig. 64.)

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[1] "Cheese and Its Economical Use in the Diet," Langworthy, U. S. Dept Agri.

[2] Loc. cit.

I. Soft Cheese

ttage cheese, or "green" cheese consists of the curdled milk itated by rennet, or by natural coagulation during the ction of lactic acid. The batch is heated from 85° F. to '. and is put into a linen bag, the whey drained off, and the ning curd salted, pressed and kneaded by the hand and sold

of cream and milk, coagulated fresh milk mixed with cream, or from a mixture of one part of cream with 6.4 parts of milk. It is in general similar to Neufchâtel, although richer in butter fat. The curd is coagulated by the use of rennet, and the mass is heated, usually to 84° F. When it has fully coagulated, the whey is drained off, and the curd is salted and packed into cakes, wrapped in impervious paper and put directly on the market without curing.

Camembert is a soft, fresh cheese usually 6 or 7 inches in diameter and 1 to 2 inches thick. The ripened cheese is covered with a reddish-brown mold and the interior is a soft buttery mass. The first cheese of this kind was made in 1791 by Marie Fontaine at Camembert, France. The temperature best adapted for its manufacture is that of central France from March to September, It is usually made from whole milk, although occasionally a part of the fat is removed. In the process of making,[1] the morning and evening milk is mixed, and heated nearly to the temperature at which it comes from the cow, rennet is added, the mixture is stirred for two or three minutes, and then covered and allowed to stand for five or six hours. The curd is dipped from the pan into cylindrical metal molds, so arranged that the whey can drain off. After it has drained for two days, the mold is turned over, the cheese is sprinkled with salt and allowed to drain for another day. At the expiration of this time the cheese is taken from the mold, and placed in the drying room on racks covered with straw. Good ventilation is necessary and the room is completely screened from sunlight, dust and insects. Several varieties of molds and bacteria develop during the ripening process.[2] The presence of a reddish mold on the surface is usually associated with excellence of flavor and texture. The imported cheese retails for about 60 cents per pound in the United States.

Brie, a cheese, quite similar to Camembert, made in the northwestern part of France, also has a strong odor almost sugng decomposition. The cheese is ripened at a temperature om 62° F. to 65° F. until the blue mold is abundant on the ce. In the process of ripening the casein is broken down and t creamy mass is formed in the interior. It is found in the et in flat circular masses about an inch in thickness, and from 16 inches in diameter.

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[1] Foods and Their Adulteration, Wiley, p. 206.

[2] U. S. Dept. Agri. Bur. An. Ind. No. 115., Bull. No. 150, Bull. No. 82.

mburger cheese originated in Belgium, and is a common uct in Germany. It may be made from whole or skimmed which is coagulated with rennet at a temperature from 92° 100° F. The curd is drained in perforated rectangular molds, ted several times and is pressed slightly between boards. he ripening, which requires from four to six weeks, is ed on at 60° F. in a very moist cellar, is closely related to faction, this cheese has a very disagreeable odor. Most of mburger used in the United States is now made in New York Visconsin.

eufchâtel cheese was originally prepared in Switzerland.

Potted or sandwich cheeses are common on the market in the United States. They are made by mixing one part of butter or oil with five parts of cheese. These may be seasoned with mustard, curry powder, or similar flavors. Chopped pimento is often incorporated in Neufchâtel cheese.

II. Hard Cheese

The *hard* cheeses are subjected to a greater pressure than the soft, and are cured in a drier atmosphere.

In the **cheddar type** of cheese, the curd is heated and the cheese is submitted to considerable pressure. This process was in use in the village of Cheddar, England, more than two hundred and fifty years ago. The successive steps followed in making this cheese are:[1] setting, cutting, heating, cheddaring, grinding, salting, pressing and curing.

The cutting of the curd may be done by the use of gangs of steel knives. The matting together of the curd after the whey is drawn off is known as the cheddaring process. The curd is cut into rectangular blocks, piled several times, and when drained, cut up or "ground" and salted before being put into the press. This cheese is ripened at a temperature of 65° F. or 70° F., and the process requires from four to six weeks. If the cheese is made from unskimmed milk it is called "full cream," and if cream is removed it is "part skim," or "skim," as the case may be. The ordinary American factory cheese or New York cheese and most of the domestic cheese is of the English chedder type. Sage cheese is a variety of chedder flavored and mottled with bits of sage, although the color is at present produced in other ways.

In the **stilton** type the curd is neither pressed nor colored. It is ripened by the aid of the mold, *pencillium glaucum.* This cheese is made in Leicestershire, England, and adjoining counties, from whole milk, sometimes with the addition of a little cream. The milk is "set" for about an hour at 80° F. and the curd is then n slices and put upon cloths over a sink to drain. The corners e cloth are gathered up and the cheese is squeezed several s, and allowed to stand until quite acid. The curd is then nto cylindrical tin molds 10 inches in diameter by 15 inches which are perforated on the sides, and stand on a board covered a cloth. The temperature is maintained at 60° F. and the es are turned over twice a day. After ten days of this ment, the cheeses are taken from the mold, surrounded with a band and taken to the drying rooms and later to the ing rooms, where they should remain at a temperature of t 65° F. for several months. The spores of the *pencillium um* have ample opportunity during this process to penetrate heese, and when ripe a blue mold will be seen mottling the e mass. The mild flavor is largely produced by the action of mold. This cheese ordinarily retails at about 75 cents a d in the United States. Other English cheeses are usually ed from the locality where they are made.

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[1] Milk and Its Products (Rev. Ed.), Wing, p. 251.

and is then put into the molds to drain. (Fig. 83.) The cheese is ripened in from eight to twelve months at a temperature of from 52° F. to 60° F.

The **Edam** cheese takes its name from a town near Amsterdam, where the manufacture of this cheese is the principal industry. Whole or partially skimmed milk is used and "set" with rennet at a temperature of 85° F. It is left in the vat for some time until quite acid. A peculiar slimy fermentation is induced by the use of some of the whey from a previous curd,[1] which contains the required bacteria. After the curd has been broken up it is put

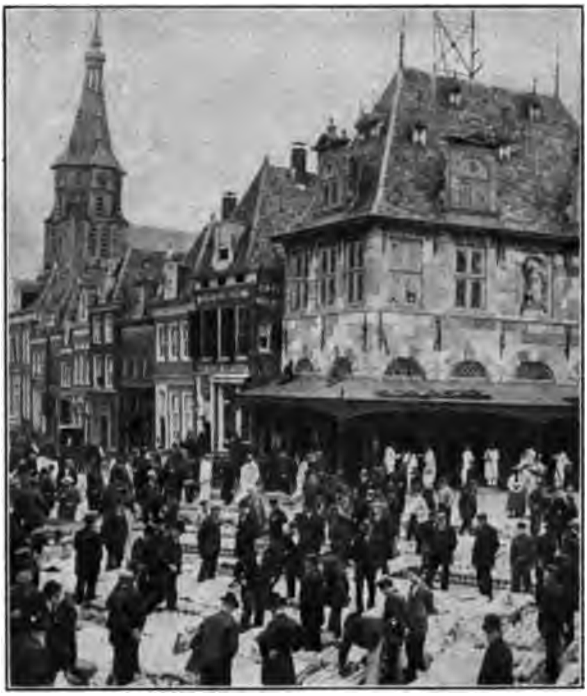

FIG. 82.—Weigh house and market where Edam cheese is sold, at Hoorn, Holland. (Copyright by Underwood & Underwood, N. Y.)

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[1] Tibbles, p. 312.

cup-shaped wooden molds about 5 inches in diameter, having
in the bottom, and here it is pressed slightly during twenty-
hours. It is salted and cured at a temperature of 68° F. by the
ary methods, and the outside is painted a reddish color.
n sold in the public markets of Holland (Fig. 82), this cheese
t fully ripened, but requires from nine to twelve months
velop the characteristic flavor. "Pineapple" cheese is the

has ripened from one to two years. Parmesan when it is very hard and dry is used for the preparation of grated cheese and is sometimes sold in a grated form. It is very popular, especially in Europe, for use in soups and for seasoning macaroni.

Roquefort is a well-known cheese, usually made from the milk of sheep and goats, especially in France. Not less than 8000 sheep in one district are kept for cheese-making. In making this cheese the curd is placed in layers in perforated tin molds, where it is pressed for some time, and then taken out of the molds and sent to the drying room. Here it remains ten to twelve days, and is then taken to the caves to ripen. These caves are cut in the limestone rocks of the valleys, and are cool and well ventilated. Frequently moldy bread is incorporated in the cheese to transmit to it the peculiar mold necessary to develop the flavor. During the ripening the cheeses are sometimes perforated by long needles to allow the germ-laden air to penetrate to the interior. The cheese-protein undergoes numerous changes in this process, so that in the ripe cheese it is soft and buttery and marbled with a grayish mold. These cheeses are small, weighing from 4 to 6 pounds.

Sap sago is a hard skim-milk cheese made in Switzerland. It contains for every 4 pounds of cheese 1 pound of the clover (Melilotus coeruleus), which imparts to the cheese a peculiar flavor and a green color.

Cacio-cavello is the typical cheese of southern Italy, especially of Calabria, and is made from the milk of sheep.

Port du salut was originally made in Normandy by the Trappist Monks. This cheese which is circular and about 1 inch thick, has a buttery consistency and a nutty flavor, somewhat like the ordinary American cheese. It is in great favor on the Continent, but not so well known in the United States.

RIPENING OF CHEESE

From what has been said of the above cheeses, it will be seen that by difference in materials, method of manufacture, tempera-of making and of curing, and conditions which induce the th of specific organisms, the great variety of cheese has been uced.

'he whole process of ripening is evidently due to bacterial ity, and to the action of certain unorganized agents known zymes which induce chemical changes by "catalytic" action, is by their mere presence.[1] As peculiar conditions are necesto produce a given product it is often impossible to produce ese having the special characteristics that belong to that ty, outside of the district where it was originally produced, heeses of the "type" of camembert, neufchâtel, cheddar, or n may be made in other localities.

ince bacteria play so important a part in the ripening of e, they are naturally abundant in the products on the market. 500,000 to 100,000,000 bacteria per gram are usually present.

DIGESTIBILITY OF CHEESE

but meat and cheese or eggs and cheese do not form well-balanced rations as they contain too much protein. As a condiment at the close of a meal of other food, cheese has always been in favor, and no doubt does assist in the process of digestion by stimulating the secretion of the digestive juices. Only 3 pounds of cheese per capita is used in the United States.

A "cheese food"[1] has been recently put on the market. This is cheddar cheese made, cured, and ground so that it can be mixed with the whey which has meanwhile been concentrated to a thick sirup. This mass is pressed into cakes, and will keep for a considerable time.

ADULTERATION OF CHEESE

In addition to the fraud of selling one kind of cheese for another, the selling of "filled" cheese for genuine is the most common deception. Filled cheese is defined as "all substances made of milk or skimmed milk with the admixture of butter, animal oils or fats, vegetable or any other oils or compounds foreign to such milk, and made in the imitation or semblance of cheese." This cheese is by law taxed 1 cent. per pound, and when imported must pay a duty of 8 cents a pound.

Filled cheese has been made extensively in some of the large dairy states, by bringing into a disintegrator, lard and skimmed milk, both previously heated to 140° F. in steam-jacketed tanks. The disintegrator contains a cylinder which revolves rapidly under such conditions as to emulsify the milk and the lard. The proportions used are two to three parts of milk to one part of lard. A measured quantity of this emulsion is then added to skim milk and buttermilk, in the manufacture of the cheese. The process amounts to the substitution of lard for butter fat in the cheese, and consequently a cheaper product is produced.[2]

Of the cheeses made in the United States, at least three-fourths rdinary American cheese, while among other varieties are the es" of foreign brands, such as neutfchâtel, cheddar and n. New York and Wisconsin together produce three-fourths e entire output of the country. The latest census figures s that not less than 320,532,000 pounds of cheese is made y in the United States. Canada exported, in 1910, over 00,000 pounds of cheese, while of the European coun- the Netherlands exported 122,000,000 pounds, and Switzer- 69,000,000 pounds.

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[1] Milk and Its Products, Wing, p. 233.

[2] Industrial Organic Chemistry, Sadtler, p. 288.

DAIRY BY-PRODUCTS

Milk Sugar (Lactose)

here are some important by-products of the dairy to which ference has thus far been made. Among these is **milk sugar** $I_{22}O_{11}.H_2O$) which is obtained from the whey after the separa- of the curd. It is made by allowing the whey to stand until ordinary yeast. Milk sugar is usually sold as a white crystalline powder which has only a moderately sweet taste. Because of this characteristic lack of sweetness it is sometimes known as "sand sugar."

Use of Casein and Lactic Acid

There are several food products upon the market which are made from the soluble alkali salts of *casein*. Some of these have milk sugar, and butter fat added to increase their nutritive qualities. These preparations are known by such names as "lactarine," "nutrose" and "sanatogen."

Casein, besides being a food, is coming into quite general use as sizing for paper, for making a glue for wood work and card board[1] and for making paper flasks, bags, and milk bottles waterproof. This is done by impregnating with casein solution and exposing to formaldehyde vapors. Casein is also used in the manufacture of wall paper, for enameling paper, for making a paint and for plastic masses. It is used in making "glalith," a substance which takes the place of celluloid, and to a small extent in making an imitation leather.

In France the glalith industry was started in 1904. The method of making is to mold and compress the casein in the presence of formaldehyde. The product is translucent, may be readily colored, and is rendered malleable, so that it can be molded into any desired shapes by heating at 150° F. in an oil bath. The solution from which the casein is separated, since it contains milk sugar, is valuable for fattening hogs.

Although lactic acid may be made by the action of bacteria on milk sugar, most of that which is used commercially is made synthetically from some carbohydrate. Several new uses have been suggested for this acid, as for the acid ingredient in baking powders, to take the place of acetic acid of vinegar, and as a substitute for citric acid in beverages.

[1] Industrial Chemistry (Tague) Rogers and Aubert, p. 831.

STATISTICS AND ECONOMICS

ı the United States the dairy industry has increas
g the last fifty years. The average yield of milk p
ısed nearly 100 per cent. and the total production
ıcreased nearly four times. The great change in p
gely due to the introduction of the factory system
ning stations, butter factories and cheese factories t
country. These are especially abundant in N
nsin, Iowa, Ohio, Pennsylvania, Illinois, Vermo
Michigan and Kansas. Under factory conditi
r and cheese can be made than on the farm, as the
nperature, cleanliness, storage, etc., can be so m
y controlled. Dairy legislation in the United
erved to foster this industry and to protect the man

CHAPTER XVII

EGGS AND EGG PRODUCTS

As a convenient and concentrated form of nourishment, the eggs of various birds have been highly esteemed from the earliest times. They are similar to meat in containing proteins and fat, and also furnish an abundance of mineral matter, especially phosphates, which are so important in building up the body.

The hen's egg, which is, of course, the most important egg on the market, has an average weight of 60 grams (2 ounces), and of this the shell weighs 6 grams, the white 36 grams, and the yolk 18 grams. A duck's egg has an average weight of 70 grams and the egg of a goose usually weighs 190 grams. The shell consists mainly of calcium carbonate (89 to 97 per cent.) and is very porous. Inside the shell is a delicate membrane which incloses the egg like a sack.

Besides the eggs of the fowls mentioned, the eggs of wild birds are used[1] in some countries. Plover eggs are considered a delicacy in England and Germany. The eggs of sea gulls, terns and herons have been extensively collected and used as food along the South Atlantic coast of the United States, and those of gulls and murres, on the Farallone Islands off the coast of California. As there is danger of exterminating sea birds by destroying their eggs, legislation has been enacted in many states to prevent their use as food. In the tropical sections of America turtle eggs are prized as food, and the eggs of the terrapin along the Atlantic coast. The eggs of fish, especially shad roe, and the eggs of the sturgeon preserved with salt, and known as caviar, are considered a great delicacy in many countries. (See p. 377.)

Many experiments have been made to increase the egg-producwer of the hen, and also to breed hens that will lay more ly throughout the year instead of so sparingly in winter. producing more than 200 eggs a year is considered of han average value. Although in most countries eggs are ld by the dozen, as they differ so much in size a much fairer l would be to sell by the pound or kilo.

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[1] U. S. Dept. Agri. Farmers' Bull. No. 128.

of coagulating and becoming insoluble when heated. This coagulation begins at 134° F. Enclosed within the white and "tethered by two cords" to the membrane of the white, lies the yolk, itself inclosed in a separate membrane.

Composition

The *white* of the egg consists of albumin—about 12 per cent.—and water 85 per cent. with 2 per cent. of fat, sugar and extractives, and 1.2 per cent. of mineral matter. Nearly all the albumin is soluble in water. The *yolk* which is yellowish-red in tint and nearly opaque is much richer in fat than the white, and contains about fifty-one parts of water with 15 per cent. of casein and albumin and 30 per cent. of oil, lecithin and similar compounds—all very valuable nutrients. The protein of the egg yolk is believed to consist very largely of a lecithin compound, which is a nitrogenous body allied to both fats and proteins.[1] Eggs also contain some phosphorous and sulfur compounds, and this accounts for the production of the ill-smelling gases, phosphine and hydrogen sulfide, when eggs decay. When eggs are brought in contact with silver the sulfur which they contain causes it to blacken on account of the formation of silver sulfide.

The composition of the whole egg as compared with meat is as follows:[2]

	Eggs		Moderately lean meat	
Water	73.7		73	
Protein	14.8	25.3	21	26.5
Fat	10.5		5.5	
Ash	1.0		1.0	

From this analysis it is evident that eggs form a valuable addition to a diet rich in carbohydrates. The combination "ham and however, is lacking in sugar and starch, and consequently is vell-balanced ration; but "French toast" or "eggs on toast" ch nearer to a satisfactory food.

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[1] J. Am. Chem. Soc. XXII, 1900, p. 413.
[2] Bull. 28 Office of Exp. Sta. U. S. Dept. Agri.

other comparision of various foods is as follows:[1]

	Ref-use	Water	Pro-tein	Fat	Carbohy-drates	Ash	Fuel value cal. per lb.
purchased.......	11.2	65.5	11.9	9.3	....	0.9	635
aporated.......	......	6.4	46.9	36.0	7.1	3.6	2525
as purchased...	......	34.2	25.9	33.7	2.4	3.8	1950
as purchased....	12.8	54.0	16.5	16.1	....	0.9	985
....	......	87.0	3.3	4.0	5.0	0.7	325
flour............	......	12.0	11.4	1.0	75.1	0.5	1650
s, as purchased..	20.0	62.6	1.8	0.1	18.4	1.0	385

DIGESTION

than those that are hard-boiled. That eggs rightly hold their position as of high nutritive value is shown by the fact that from experiments made by the U. S. Department of Agriculture, the coefficient of digestibility, that is, the per cent. of the nutrients actually digested, is for the protein of eggs 97 per cent. and for the fat 95 per cent.

COOKING

Eggs are capable of being *cooked* in a great variety of ways, and thus diversity can be given to the diet, but in general the simplest methods of cooking are the best. If an egg is boiled only two minutes, the albumin next the shell is coagulated, while the yolk remains fluid; if boiled three minutes, it is sometimes termed "solid boiled,"[1] while if boiled for ten minutes or more it is termed "hard boiled." The albumin first begins to coagulate at 134° F., and at 160° F. the whole mass is coagulated. The yolk has been found to coagulate at a lower temperature than the white. The method of plunging the egg into boiling water and boiling for three or four minutes is not to be recommended.

Eggs are much more evenly cooked if put into a vessel of boiling water, covered and immediately removed from the fire. For two or three eggs a quart of water is sufficient, and the eggs will be found to be "soft boiled" in four or five minutes. These are sometimes called "coddled" eggs. The exact time must be regulated according to the coldness of the eggs, the composition and size of the vessel in which they are cooked and the number of eggs treated. The temperature of the water should remain between 170° and 185° F.

In the poaching of eggs it has been recommended that a little vinegar be added to the salt water in which they are cooked, in order to assist the coagulation and prevent loss. Fried eggs are not as digestible as those cooked in other ways, as the coagulated albumin coated with fat is not as readily attacked by the gastric juice. An omelet is considered one of the most delicate and at-ve of egg preparations, but the different portions of the eggs nevenly cooked.

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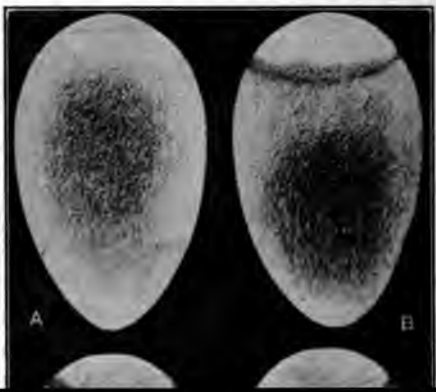
[1] Loc. cit.

QUALITY OF EGGS

s eggs belong to the class of perishable products, it is evident great care is necessary in *transporting* and *keeping* them so



(Fig. 68.) In this process the egg is held in a hole in an opaq shield and viewed by a bright light on the farther side. As t egg becomes older the air space at the end of the shell can readily seen to be larger. The appearance of the yolk and its moveme as the egg is rotated also assists the candler. If incubation h begun, a dark spot which is larger as the time of incubation greater, is visible. "Spots" which are also seen in the process candling, are particles of fungoid growth or the developing embry "Spot" eggs may be of various ages, and are of course inferior f food purposes, although often forced on to the market by the dea ers (Fig. 85). Heat is the most prolific source of destruction eggs, and in transit from the farm to the consumer, eggs are like to be exposed for a longer or shorter time to a high temperatur At a temperature of 86° F. to 91° F. an ordinary summer hea seven or eight days only are required to equal the normal he of incubation.[1]

Preservation—Preparation for Market

The best method of keeping eggs is by *cold storage*, at a ten perature of about 32° F. Eggs placed in cold storage in co weather, it has been asserted, will be in better condition in mi summer although older, than those so stored in May or Jun Some packers more recently have asserted that eggs packed ju before hot weather comes on, will remain fresh longer than tho packed in cold weather. It is by no means implied that col storage eggs are as good as fresh eggs, but they are frequently th only product available in the large cities, especially during th winter months. From experiments made by the U. S. Dept. Agriculture, and elsewhere, it is evident that there should howeve be some limit to the time which eggs are allowed to stay in col storage before they are marketed.

A convenient method of handling eggs, and of keeping the for a limited time is by *freezing* the broken eggs. This is accom plished frequently under the most sanitary conditions, by firs ling" the eggs, then breaking each egg carefully, so as to the use of any of inferior quality, mixing them thoroughly use of a mechanical stirrer, in a vessel surrounded by cooled (see Fig. 86), and finally running the semi-liquid mass into ns, holding from 30 to 50 pounds, and freezing the pro- mmediately. The eggs prepared in this way will keep for time, in cold storage, and are extremely convenient for bakers and large food manufacturers. The eggs used in

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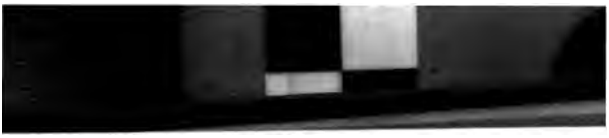
[1] Year Book U. S. Dept. Agri., 1910.



the commercial broken eggs, described above. Borax is used in some countries to preserve the broken egg product. The Chinese preserve duck's eggs by packing them in lime; this is known as "Pidan."

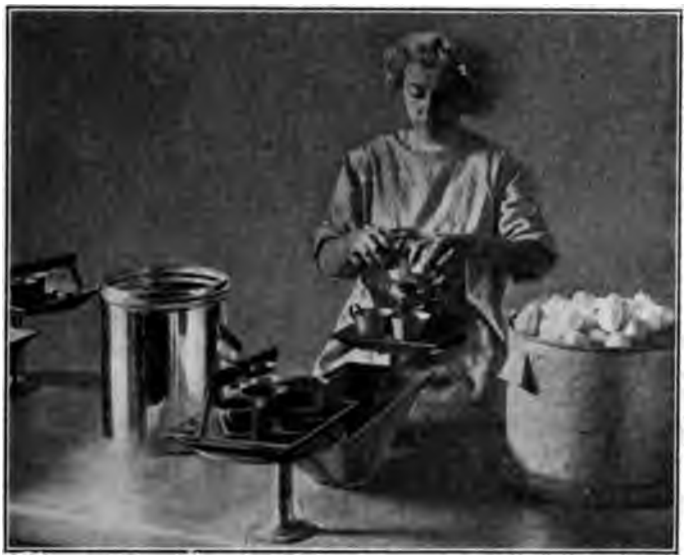


FIG. 87.—Separation of yolks and whites of eggs previous to freezing. (By permission Seymour Packing Co.)

Use of Preserving Solutions

Among the methods that are used for preserving eggs in small quantities, there are two that have been found fairly satisfactory. The first is by covering the eggs with lime water. This method has many advocates, although others urge that the flavor of the egg is liable to be injured by the lime which penetrates the porous shell.

The second method is by the use of a solution of water glass (sodium silicate).[1,2,3] To obtain good results, the eggs should be

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[1] C. A. 11, p. 504.
[2] U. S. Dept. Agri. Bur. Chem. Bul. No. 115.
[3] Eighth International Cong. of Appl. Chem. Sec. viiic, p. 51.

It is important to note that *unfe*
than those which have been fertilize

Egg Preparat

On account of the difficulty of kee
dried eggs and egg powders have been pu
cated eggs can be prepared by spreadi
of a slowly revolving cylinder, upon wh
blown, or the semi-liquid eggs can be
or sugar is sometimes added to assist
A recent method of drying is by allowi
in a thin stream upon a wide block-tin
over revolving cylinders, in such a way t
heated carefully, but never to a tempe
the albumin be coagulated. This prod
and dried more completely in wire bo
barrels for transportation. It is intende
and must be kept in cold storage. From
fulness there is no objection to desiccat
stock in the proper

of course worthless, consist largely of starch or flour, colored with aniline yellow, so as to resemble eggs. They may not be injurious, but they are intended to lead the customer to think he is getting something "just as good" as eggs; when as a matter of fact he is buying at a high price, cheap materials which have none of the properties of eggs.

Eggs are produced all over the United States, but it is only the states of Ohio, Indiana, Illinois, Iowa, Minnesota, Nebraska, Kansas, Missouri, Texas, Tennessee and Kentucky that produce more eggs than are needed for home consumption, and can export to their less fortunate neighbors.

England is largely dependent on the Continent for its egg supply. The price of eggs in the United States varies with the time of the year, but in general is gradually increasing.

The new American tariff, placing eggs on the free list, has resulted in the importation of a large number of eggs from China. The importation of dried or frozen eggs has increased since the armistice was signed. This amounted to nearly 25,000,000 pounds in 1919. At the same time we exported over 38,000,000 dozen fresh eggs to foreign countries.

Spices and condiments are of extren
They are used to communicate an agre
food, and to stimulate the appetite. Wi
of common salt none of these substance
solutely necessary to the human body.
used with moderation by middle-aged
increased pleasure in partaking of food,
children should not be encouraged. Co
regarded as food, for they do not contribut
ment of the body, but they are to be con
accessories."

ESSENTIAL OIL

Many of these substances owe their pr
of a volatile oil, which excites the nerves
thus increases the desire for food, or as we
essential oil which many of them contain
with steam, and forms an important arti
oil is sometimes used in the place of the m
made, as in the case of the oil of clove
These oils usually contain a number of

thus: 1. *From stems or leaves;* 2. *from buds or flowers;* 3. *from the bark;* 4. *from roots or rootstocks;* 5. *from immature or ripe fruits;* 6. *from seeds.*

1. FROM STEMS AND LEAVES

Bay leaf (Laurus nobilis L.).—The sweet bay as it is called is used as a condimental substance in food. It is a native of the Mediterranean but grows in sheltered gardens in temperate climates. The oil of bay, which is used in making bay rum, is obtained from a different plant, the Myrcia acris.[1]

Sage (Salvia officinalis L.) is an ordinary perennial garden herb, growing wild in southern Europe, and is cultivated in old time gardens. The leaves, which are the official portion, are grayish green, hairy and very aromatic. From these an aromatic oil may be distilled. It possesses slightly tonic, astringent and aromatic properties. Its chief use is in flavoring meats, especially sausage, and the "stuffing" of fowls.

Spearmint (Mentha spicata L.) is the dried leaves and tops of a perennial herb, which is a native of Europe and Asia but has become naturalized and is found in moist places in many localities in the northern United States. It somewhat resembles peppermint, but can readily be distinguished from it both by appearance and odor. The plant is used especially in flavoring "mint sauce," which is served with mutton. The oil of spearmint is largely distilled in this country, the whole plant being used for this purpose.

Sweet majorum (Origanum majoranum).—This plant grows wild in Portugal and Andalusia, is a native of North America, and is cultivated as a garden herb in many countries. It yields a volatile oil when distilled with steam. The plant is used in medicine and for flavoring.

Sweet basil (Ocymum basilicum L.).—This is an aromatic plant which is a native of India and Persia,[2] but is cultivated in gardens throughout the temperate zone. The leaves are used for upon distillation.

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[1] U. S. Dispensatory, p. 1589.

[2] Loc. cit., p. 1584.

Peppermint (Mentha piperita L.) or wild in moist places in almost all countri It is also cultivated for making the esse states of Michigan, Indiana and Nev has a strong, pungent taste, "followed b air is drawn into the mouth," is not so foods as in beverages and confectioner is obtained from oil of peppermint.

Parsley (Apium petroselinum) is an is a native of Sardinia and parts of readily cultivated. All the parts of t to which the flavor is due. A peculia which suggests pectin because it readily is obtained by boiling the herb with wat parts of the plant are used in medicin sumed in garnishing and flavoring food duce any medicinal effects.

Tarragon (Artemisia dracunculus) is a for its pungent, aromatic leaves. They as a flavor in western Asia. Their prin

Synthetic *methyl salicylate* is very commonly substituted for both wintergreen and sweet birch oil, and sweet birch oil in turn for wintergreen oil.[1]

Thyme (Thymus vulgaris L.) is cultivated in gardens throughout the temperate zone, and is a native of the Mediterranean region. There are several allied varieties growing wild having quite similar properties. The oil of thyme, which is produced from the leaves by distillation, contains from 25 to 42 per cent. of *thymol* ($C_{10}H_{13}OH$). Thyme is used for flavoring foods.

2. BUDS AND FLOWERS

Caper bush (Capparis spinosa L.).—Capers are the buds or unexpanded flowers of a low trailing shrub that grows abundantly along the shores and on the islands of the Mediterranean. It is found growing wild in central and southern Italy, and is cultivated in that country and on the islands of Sicily and Majorca, as well as in France and Spain. The fresh buds gathered every morning are treated with salt and vinegar. The smallest and greenest are considered of the finest quality. Capers are used especially for flavoring meats and in pickles. The peculiar flavor of capers is due to the presence of capric acid. They are sometimes adulterated by the substitution in part of other flower-buds.

Cloves (Eugenia caryophyllata or Caryophyllus aromaticus L.). Cloves are the dried flower buds of an evergreen tree which is a native of the Molucca Islands. It is cultivated throughout the East Indies, in East Africa and in the West Indies and Brazil. The tree grows to a height of 30 or 40 feet and begins to bear when it is about six years old. The cloves are dried in the sun or by the heat of a wood fire. Cloves contain from 17 to 20 per cent. of the volatile oil of cloves, and about 8 per cent. of oleo-resin. The oil is obtained by distilling the cloves with water, and it is to the presence of this oil that it owes the agreeable flavor and aroma. This oil consists of about 90 per cent. of a substance called "eu-

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[1] Food Inspection and Analysis, Leach, 4th Ed. p. 947.

tops of the styles of a perennial plant which c
Asia Minor, but is now cultivated in many
Europe and Asia. It is chiefly used in med
color and flavor to food.

3. BARKS

Cassia (Cinnamomum cassia and seve
is the inner bark of various trees having
quite similar to cinnamon, and often used a
the genuine cinnamon. It contains a volatile
cinnamon. The best grade is from Saigon, an
China. The flower buds are put on the mark
of "cassia buds," which are also used for flav

Cinnamon (Cinnamomum zeylanicum, B
or Ceylon cinnamon and is the inner bark
cultivated throughout the East Indies and
countries. The longitudinal strips of bark
the trees, cured and dried, and made into bu
This bark contains an essential oil, usually les

4. ROOTS AND ROOT-STOCKS

Turmeric (Curcuma langa).—Turmeric is the rhizome of a perennial plant growing in the East. The root is dried and frequently ground before being put upon the market. It contains a yellow coloring matter, and the powder has a warm, bitterish, somewhat aromatic taste. It is used for coloring and flavoring food products.

Garlic (Allium sativum) bulbs, which are much more commonly grown in Europe than in the United States, are used in flavoring, sauces, etc. (See Onions.) The odor is due to an essential oil, which is supposed to consist largely of allyl sulfide (C_3H_5S or allyl sulfocyanide (C_3H_5NCS).

Ginger (Qingiber officinale).—Ginger is the creeping rhizome of a plant which is said to be a native of Hindostan, but is cultivated in the East and West Indies, Africa, China, Japan, and in fact almost all sub-tropical countries.[1] The root is sufficiently grown when it is a year old. It is scalded in boiling water, rapidly dried and thus prepared constitutes the "black ginger" of commerce. In Jamaica the white or Jamaica ginger is prepared by peeling the fresh rhizomes and mascerating them with water or lime juice, and drying in the sun. Inferior grades are often bleached with sulfur or whitened by dipping into a mixture of calcium sulfate or chalk and water. "Limed" ginger has come to be a regular article of commerce. Ginger contains an oleoresin, a volatile oil and nearly 50 per cent. of a peculiar starch. The flavor is due to the volatile oil and the pungency to the oleoresin. The extract and "essence" is much used in the preparation of beverages. The "fortifying" of Ginger Ale, with capsicum, in the making of this beverage is not allowed.

Horseradish (Cochlearia armoracia L.) is the root of a plant which is a native of western Europe and is extensively grown on both sides of the Atlantic. The virtue of the root is due to the presence of a volatile oil, which is dissipated by drying. The root is grated and preserved in vinegar for use. The oil consists

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[1] U. S. Dispensatory, p. 1526.

Sassafras (Sassafras variifolium).—This is
ing along the Atlantic coast, and to the inte
States. The bark of the small stems and esp
is the part used. The root and the volatile o
are used in flavoring beverages and confectione

5. IMMATURE AND RIPE FI

Allspice (Pimenta officinalis).—Allspice is
nearly ripe fruit of an evergreen tree, growing
30 feet, which is a native of the Caribee Islan
Jamaica, Mexico and the northern part of So
berries, in order to have the best flavor shou
green, and are then dried in the sun or in a
oil which is present to the amount of from
has a fragrant odor which resembles somew
of other spices.

Capsicum—cayenne pepper—(Capsicum
several other species. There are several spe
the cayennes are hot and the "paprikas" are
cultivated in both the temperate and sub-tro
the pungent varieties are more extensively us

Juniper (Juniper communis) is a dark blue berry, borne on an evergreen tree that is one of the most widely distributed trees of the northern hemisphere. It grows as far north as the arctic circle, and the trees differ greatly in size and shape in different latitudes. The fruit matures during the second season, and is used medicinally and for making an aromatic oil. The crushed berry or the oil is used in flavoring gin. (See p. 147.)

Pepper (Piper officinarum—Piper nigrum L.).—Piper nigrum L. grows wild in China and various parts of India and is cultivated principally in the East Indies. This is a perennial plant, which is propagated by cuttings, and as it grows must be supported by props or other trees. The tree begins to bear three or four years after it is planted and produces two crops a year. *Black* and *while* pepper are the fruit of the same tree, but treated in different ways. The berries which are gathered before they are ripe, are dried in the sun, and beaten on mats to detach them from the stalk. This constitute the *black pepper* of commerce. For the preparation of *white pepper*, the berries are allowed to become red or even black before they are gathered, and then are permitted to stand until a certain amount of fermentation takes place. They are then rubbed between the hands to remove the pericarp and pulp, dried and blanched. The white pepper is much less pungent, but more aromatic than the black. One of the most important ingredients of pepper is *piperin* ($C_7H_{19}NO_3$), an alkaloid-like substance. Pepper also contains an oleo-resin and a volatile or essential oil ($C_{10}H_{16}$), which contribute flavor and pungency to the product. *Cayenne pepper* is the dried ripe fruit of the Capsicum fontescens L. Adulteration is not common at present.

Vanilla Bean (Vanilla planifolia, Andrews).—Vanilla is the dried and cured bean of an orchid which is indigenous to Mexico, but is also cultivated in the West Indies, Central and South America. The best cured beans of commerce are from 20 to 25 centimeters long, and drawn out at the ends and curved at the base. They have a very characteristic dark brown color, are waxy to the touch, and often covered with fine crystals of vanillin.

Coriander Seed (Coriandrum sativu
native of Italy, grows wild in some part
cultivated. The volatile oil has an agr

Cumin Seed (Cuminum cyminum L
Egypt, and at present cultivated larg
This is an annual umbelliferous plant, wl
similar to the coriander in flavor. It
Germany the peasants are fond of brea
cumin, and in Holland it is used to fla

Dill (Anethum graviolens L.).—The
Portugal and southern France, and is
Europe and America. The seeds are used
flavoring, and in preparing a special
"dill pickle." The flavor is not as agree

Fennel (Fœniculum vulgare L.).—Fen
native of Europe, and is common in all te
seed yields four or five per cent. of volati
aromatic taste. It has escaped from c
and grows so abundantly that the seed
for making oil.

Grains of Paradise (Amomum

family *Cruciferæ.* They are cultivated in gardens and in fields and in some places grow wild. Both the black and white mustard are important condimental substances. The plant is an annual, bearing yellow flowers, and the seeds may be separated from the pods when ripe by threshing. Mustard contains a *fixed oil* which is present to the amount of from 20 to 30 per cent. This may be expressed from the powdered seeds, after warming. It is a bland oil, with very little taste, and forms an excellent salad oil. (See Fats and Oils.) Much of the fixed oil is frequently removed before the seeds are prepared as "ground mustard." Mustard also yields, when the seeds are moistened, under the influence of the *myrosin* an enzyme, a volatile or essential oil, but this does not exist ready-formed in the seeds. The active principle of black mustard is *sinigrin,* and that of white mustard is *sinalbin.* These are the substances which break up to yield, among other products, the volatile oil. The strongest "ground mustard" is obtained by mixing the two varieties of seeds. As starch is not a constituent of mustard, adulteration with this substance is easily detected. Formerly the "prepared mustard" put upon the market in the United States, was grossly adulterated. Charlock[1] or "wild mustard" which grows abundantly in the grain fields of the Northwest, is one of the common adulterants of mustard. The uses of mustard in medicine, as a condiment, and to stimulate the appetite are well known.

Nutmeg—Mace (Myristica fragrans Houttuyn) and other varieties. Nutmegs grow on a tree about 30 feet high, which somewhat resemble the orange tree.[2] It is a native of the Molucca and neighboring islands, and is cultivated especially in the East Indies, Madagascar and the West Indies. The trees are started from the seed, but when they are about two years old they are cut down and grafted with branches of the female tree to insure fruitfulness. A few male trees are left in the orchard to insure fertilization. The trees continue bearing for seventy or eighty years.

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[1] Bailey and Burnett. J. I. E. C. Vol. 8, p. 429.

[2] U. S. Dispensatory, p. 797.

subject to a tax, and salt used for c
natured," by the addition of some foreign
not be fit to use for seasoning food.

Dietetic Use of Common

The amount of sodium chloride taken wi
that the chlorine contained in foods in the
is of no importance. It is interesting to not
the herbivora require salt in their food, wh
not. In discussing the natural craving for sal
and the herbivorous animals, Bunge[1] (Physi
logical Chemistry) explains it about as follows:
are rich in potassium which is ultimately eli
of mineral salts, largely as sulfate. Potassium
reacts to some extent with sodium chloride
chloride and sodium sulfate, both of which ar
by the kidneys. Hence the greater the amo
food, the greater the loss of sodium and chlo
and the greater the necessity for salt to k
sodium chloride content of the body." B
this discussion concludes that while

CHAPTER XIX

NON-INTOXICATING BEVERAGES

From very early times man has prepared mildly stimulating non-intoxicating beverages from various vegetable substances. It is rather remarkable that people of different nationalities, living under entirely different conditions of civilization, some earlier and some later in the history of the development of the race, should have felt the necessity, or should have appreciated the satisfaction to be derived from the use of this class of beverages, and that they selected for making them plants that contained, in a general way, similar constituents.

The most important principle contained in these beverages is the *alkaloid*, a nitrogenous substance which has stimulating properties. Tea, coffee, and cocoa contain also a volatile oil, which gives an agreeàble odor and taste to the beverage, and a considerable amount of an astringent principle related to tannin, which modifies the taste and has also a physiological action on the system. Other plants, used more generally in South America, Africa and the East Indies than in North America and Europe, are the **Maté**, **Khât**, Kola, Guarana and Coca, and these contain similar constituents.

TEA (Thea chinensis)

History

The tea plant grows in sub-tropical regions which have a rainfall of 60 inches or more. The species found growing wild in Assam and Burmah is supposed to be the progenitor of the modern tea plant. Some species still grow wild in the moun-

[illegible] day he found growing in the same sp
leaves of which furnished a beverage that
Tea has been used in China for four thou

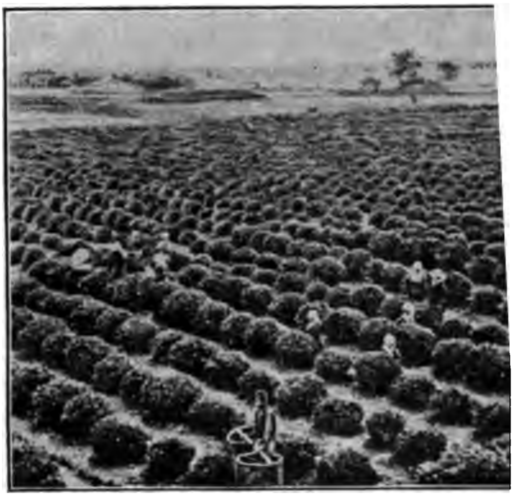

Fig. 89.—A tea plantation in China. (By permissi

The tea plant was introduced into Japan in the

Cultivation of the Plant

The tea plant is a small shrub, growing to the height of 3 or 4 feet if cultivated, but if allowed to grow without pruning it reaches a much greater height. (Fig. 89.) The plants are started in the nursery from seeds, and then transplanted to the field where they are set in rows about 4 feet apart. The vigorous pruning to which the shrub is subjected causes it to send out numerous young shoots. The leaves are ready for picking in three years after the plant is started, and in some countries as India are picked as often as twenty-five times a season.[1]

Manufacture of Tea

There are in general two kinds of tea on the market, green and black, both made from the same stock but by different methods of treatment. *Green tea* is made by first drying the leaves and then heating them below the boiling point of water with constant stirring in a pan over a fire, or with steam. The next process is to roll the moist leaves into balls by hand, allow them to sweat for a short time in heaps and again roast them gently. By this process the aroma is distributed and the green color is retained. The leaves are then sifted and sorted into different grades, and again roasted. In some countries a part of this process is done by machinery.

Black tea is made by first withering the leaves on trays in the sun then tossing them in the air until they are soft, and finally piling them in heaps in a cool place to ferment for some hours. When the fermentation is complete the leaves are heated over a fire, then rolled by hand upon a rattan table. Some of the black teas, as the Congous, are heavily fermented. Once more the leaves are exposed to the sun, and then roasted and rolled a second time. After roasting and rolling three times, the tea is sifted, dried and packed. Great skill is necessary so that the leaves be fermented and roasted enough to eliminate the raw flavor, de-

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[1] U. S. Dept. Agri. Div. Chem. Bul. 13, pt. 7.

In the process of manufacture of tea th
the volatile oil has an opportunity to diff
mass. Much moisture is lost in the curi
25 pounds of tea is obtained from 100 pou

Composition of Tea

The average composition of tea leave
is as follows:

Water....................................
Nitrogenous substances....................
Thein (or caffein)..........................
Essential oil...............................
Fat, chlorophyl and wax...................
Gum, dextrin, etc..........................
Tannin.....................................
Pectin, etc.................................
Crude fiber.................................
Ash...

The most important of these constit
(or caffein) volatile oil and tannin; and

This is not true, however, of the Indian teas. According to Y. Kozai[1] the following analyses show the relative quantity of some of the important ingredients in green and black teas.

	Green tea	Black tea
Crude protein	37.43	38.90
Fibrin	10.06	10.07
Ash	4.92	4.93
Theine	3.20	3.30
Tannin	10.64	4.89
Total nitrogen	5.99	6.22

It will be noticed that the important difference in the two kinds of tea is the greater per cent. of tannin contained in the green tea. In the process of manufacture of black tea, some of the tannin is oxidized and made less soluble. The chief agent in the fermentation and coloring of tea is an enzyme or oxidase which is present in the leaves.[2] There is the largest quantity of this enzyme in the tip leaf of the shoot, and the least in the old leaves. The leaves containing the highest per cent. of this enzyme are those that give the highest flavored teas. It has been shown that this enzyme converts some of the tannic acid into glucose.[3]

It is stated[4] that the principal constituents of the essential oils, which give the characteristic aroma to tea are originally present in a glucosidal combination, and are liberated by hydrolysis during the fermentation of the tea.

Varieties of Tea

The numerous varieties of tea are due to the country in which the plant is grown, on the altitude, the climate, and especially on

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[1] Practical Dietetics, Thompson, p. 211.

[2] Maun, J. Asiatic Soc. Bengal, 70–154. Abst. J. S. Ch. Ind. Vol. 21, p. 716.

[3] Newton, J. Soc. Ch. Ind., Vol. 21, p. 182.

[4] Hartwich and Du Pasquier, Apoth. Ztg., 24, 109. (Abst.) Chem. Abst., Vol. 3, p. 2594.

of the caffein. If the water is fresh
ously for two minutes, and is then pou
allowed to stand in an earthenware tea
then poured off into another heated
contain a minimum amount of tannin
aroma. Boiling or steeping for any le
injures the delicate flavor of tea. By
in which about a teaspoonful of tea is pl
make the tea of whatever strength he de

About 5 grams (75 grains) of tea, wit
should be used in making five cups of
tea ordinarily contains 0.4 grams of
0.025 of thein.[1] There are quite a larg
bodies in the tea infusion in addition to t
a xanthin, a diuretic base, an acid, g
matter. Although it is possible to extra
from 31 to 44 per cent. of extractive ma
sion if properly made, seldom contains mo

The kind of water used in making te
An absolutely soft water which dissolve
terial. does not give

when the digestive system is weakened. It assists in mental and muscular work, accelerates the circulation of the blood,[1] renders active the functions of the skin and the excretion of the urine, and reacts beneficially upon the greater part of the other functions. An excess of tea is however apt to precipitate the digestive ferments, retard digestion and produce insomnia and nervousness. Tea should be avoided by those who suffer from dyspepsia or constipation. The "tea habit" produces overstimulation followed by depression and later by muscular tremors and palpitation. Tea is not a food, although if cream and sugar are used with the beverage a small amount of nutriment is thus obtained. Lemon juice added to tea often makes it more acceptable. Tea is not an expensive beverage, and so it is utilized and appreciated by people of small means. A very high grade of tea only costs 1/2 cent per cup, and a grade that sells at 50 cents per pound affords the beverage at the rate of from four to six cups for 1 cent.

In the United States the amount of tea used per annum per capita is about 1 pound, while in England it is 6 pounds, and in Australia 7 pounds. In the whole world it is estimated that 2,500,000,000 pounds of tea are consumed each year. For use in the United States 80,740,576 pounds was imported in 1919, and over eight and one half million pounds of siftings, sweepings, etc. for manufacturing purposes.

TEA SUBSTITUTES

Coffee-leaf tea is an important beverage in some coffee-producing countries, and the beverage has about the same constituents and properties as ordinary tea.[2] Other beverages are made from herbs which contain essential oils or flavoring materials, and these, when made into hot infusions, have a slightly stimulating effect, although the herbs do not contain the active principles of tea and coffee. Among these beverages may be mentioned, sage tea, mountain tea (Gaultheria procumbens), Labrador tea (Ledum palustre), anise tea, sassafras tea, peppermint and spearmint tea, etc.

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[1] Diet and Dietetics, Gautier, p. 273.

[2] Church, Foods, p. 220.

Brazil.[1] As a beverage it has been traced t
who first used it in 875. Coffee was greatly p
medan priests, and was extensively used
hibited by them, as a knowledge of its virtu
from Persia westward to Cairo, Syria and C
Dutch traders in the seventeenth century tr
plant from its original habitat in Arabia an
colonies in Java, and Batavia. They introd
Indies and began the cultivation of the plant i
introduced by the English into Jamaica, an
Martinique. The extensive coffee plantati
islands are the progeny of a single plant brou
1720 by a French officer. A Franciscan m
seeds to Brazil in 1774. There are seve
introduction of coffee into England, but its
when used by a Cretan student in Oxford i
merchant is said to have set up his Greek ser
in Cornhill (London) in 1652, and the same
house in Holland shortly after. The first co
in Paris in 1671. The early English and I
troduced coffee into the United States, but

than 8 to 12 feet tall but the wild tree readily grows to a height of 20 feet or more.

The trees begin to bear when three to five years old and are productive from twenty to thirty years. They are raised from seeds planted in nurseries, and when eighteen months old, the plants are transferred to the plantations, where they are set 8 or 10 feet apart. The leaves are dark green and glossy, and the berries are borne at the base of the leaves. (Fig. 90.) The trees, which are evergreen, are pruned to a height of from 4 to 6 feet, so that the berries can be conveniently picked. Frequently only one seed is borne, in each berry, and this is known as the "male" "virgin," or pea berry. This is popularly supposed to be of

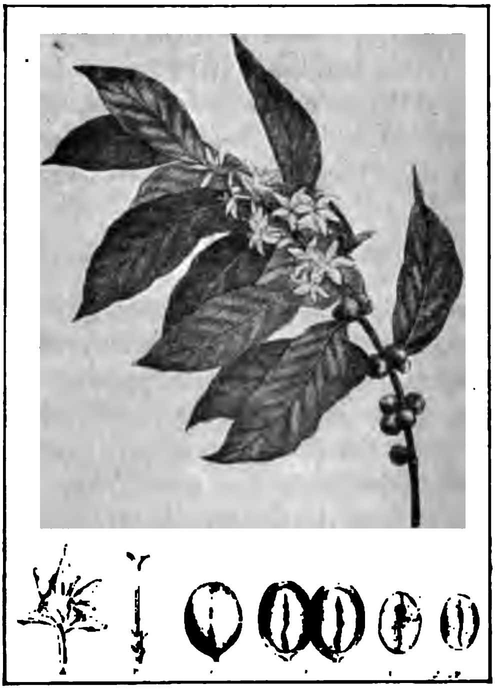

FIG. 90.—Coffee branch, with flowers and berries. (Thurber in "Coffee from the Plantation to the Cup.")

called the "parchment," lined with the
closes one bean or the two beans lying fa

The picking of the berry begins in Ja
three or four months, while in Brazil the
in April and continue the work until Sep

Preparation of Coffee for

The original method of "pulping" the
still in use in Arabia and some parts of
berries, on racks in the sun, and then ren
pulp by passing the berries through a ma
which is run by hand or power. The pri
Ceylon is to pound the berries in a mortar
the hull is removed from the rice kernel. I
put into a rough mill and are rolled around

In the West Indies by the method of h
common use, the fresh berries are carried by
machine between a revolving iron cylinde
curved sheet of metal. By this operation t
carried away by the water and the

treatment, are sent to the place of shipment. Here they are again dried and passed between rollers to crack the outer envelope or silver skin, which is finally removed by winnowing.

Coffee Roasting

As with tea, a certain amount of firing is necessary to develop the flavor, so coffee requires roasting before it can be used to prepare the beverage.

Before roasting all the light material such as sticks, dust, and chaff is removed from the product, and after roasting the coffee is drawn upward by a current of air, leaving behind the heavy refuse such as small stones, pieces of iron, etc. Roasting may be carried on in a small way in the kitchen with each pound purchased, but it is much better and more uniformly done on a large scale by the professional coffee roaster. This process requires great skill for if not roasted sufficiently the product will lack aroma and flavor, and if the coffee is overroasted, it will be bitter and acrid. The ordinary method of treatment is in a rotary roaster over an open fire. The best temperature is not much above the boiling point of water, but as each coffee or mixture of berries requires different treatment, no definite directions can be given for the process, and it is often carried on at a much higher temperature. During this process from 12 to 20 per cent. of moisture and volatile matter is driven off. Organic matter, 10 per cent. of the fat, 21 per cent. of the caffein and other organic substances are lost during the operation, and caffeol is developed. Recently a method has been devised for saving and purifying the caffein which deposits in the flues above the coffee roaster. The average loss in weight of coffee by roasting is 16 per cent., and to this fact and the additional labor which is thus required, must be attributed the higher price of roasted coffee over that of the green berry. Ground coffee should always be packed in air-tight cans, so that the flavor may be retained.

water. The water, which should not
drawn, should be allowed to boil *tumultuously*
only before it is poured over the coffee.
allowed to boil for four or five minutes, and
as soon as the grounds settle. If a little cold
or a little egg albumin be mixed with the coff
of the boiling water, the settling and clarific
will be facilitated. Soft water extracts mo
from the berries than does hard water.
the coffee it should be placed in the cup
poured. A comparatively new tin coffe
but an old tin coffee pot, from which cons
worn off will injure the flavor of the bevera
excellent metal to use for this purpose and
a long time. A copper, or nickel-plated cof
results.

3. The process of *decoction* is the one
Turkish coffee. The requisite amount of t
is placed in a small coffee pot, cold water
it is heated to the boiling point. This is th
without settling. The Turks swallow the

action; it acts as a diuretic and often counteracts nervous exhaustion. If taken in moderation, it does not tend like tea to produce constipation, but has the opposite effect. Coffee would not be considered a food from a nutritive standpoint, although it has some effect in preventing tissue waste.

Coffee, also, has its evil effects. If strong coffee is taken after dinner, it tends to retard digestion for those who have dyspeptic tendencies. The continuance of the practice of drinking strong coffee to keep awake or to be able to do an extra amount of work, produces the "coffee habit," and the symptoms of nervousness, heartburn, dyspepsia, and insomnia follow. A cup of strong coffee in the morning soon becomes an absolute necessity before any work can be accomplished. The action of coffee as a whole upon the system, is quite different from the action of either of its principal constituents, that is the caffein, volatile oil or tannin separately.[1]

Varieties of Coffee

Brazil is by far the greatest coffee-growing country in the world. Venezuela and the Central American States stand next in rank as coffee producers. Since coffee is raised in so many different localities, under widely different climatic conditions, the varieties are necessarily numerous. To this must also be added the fact that the coffee in these countries may be from a different stock, and has been variously changed by cultivation.

Mocha coffee comes from Yemen a small district in Arabia where for more than 400 years it has been an important crop. It grows in an excessively hot region where shade and irrigation are indispensable.[2]

The excellence of this coffee is said to be due to the dryness of the climate, the granitic character of the soil, and to the fact that the coffee berries when ripe are never picked but are allowed to fall from the trees of their own accord, and to dry naturally, after which they are hulled by the simplest and most primitive methods.

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[1] For Toxicity of Caffein, see U. S. Dept. Agri. Bur. Chem., Bull. No. 148.

[2] Coffee from Plantation to Cup, Thurber.

in the United States, although a larg
imported under that name is actually
Celebes and Sumatra. In the island o
under the direction and control of the I
each family was obliged to care for
government superintendence, and fro
term "Old Government Java." Java
drying process in covered "go-downs"
It is sometimes kept for four or five
on the market. The beans are larger
a yellowish brown color.[1] Other East
Mysore, *Neilgherry*, and *Coorg*. A com
of coffee is raised in Ceylon, and this is u
ing with other varieties.

The *Liberian* coffee first raised in
that name, has attracted some attention
large quantities. This variety of coffe
in hot, moist lowlands, and is also culti
coffee countries.

Some of the best-known coffees of the
San Domingo, *Hayti*, *Porto Rico* and *C*

"Bogota" is a species of coffee transplanted from Java to the mountainous regions of Colombia. While possessing some of the characteristics of the true Java, it is less expensive. It is a large well-developed bluish-green bean, furnishing a deep chocolate brown beverage.

From *Colombia* a variety known as "*Bucaramangas*," or "Bucho" is also obtained. From Venezuela, comes the *Maracaibo*, of which there are five varieties. The natural bean is large, round, solid and of a deep rich yellow color. There are several varieties of coffee grown in Mexico, especially in the southern provinces. One of these the "*Oaxaca*" growing in the mountains furnishes a heavy, strong beverage and is useful for blending with other varieties. Another, the "*Cordovas*" which is quite well known, is grown in Vera Cruz, and is an unusually large yellowish bean.

More than half of the coffee supply of the world comes from Brazil. It comes from San Paulo, and is shipped under the name of "*Santos*," the port of the province; from Rio de Janeiro, and bears the name of "*Rio;*" from Esparento Santo which produces "*Victoria*" and "*Bahia;*" and from the province of *Minas Geros*, which is shipped under the name of "*Minas*."

The *Rio coffees* are heavy in body, and in "cup quality," are pungent with a "bitterish bite" or after-taste. Victorias and Bahias are not extensively used in the United States, while the Minas have the characteristics of both Rios and Santos coffees. Santos coffees are mild and fragrant "in the cup," entirely different from the rank quality of the Rios. They are used mostly for blending. A Bourbon Santos is a transplant of the Mocha plant to the Brazilian soil, and although it resembles the Mocha in many respects, it has not the bitter flavor of the latter.

Adulteration and Falsification

The substitutions and adulterations in the coffee trade are very numerous. It is a common practice to sift or pick the berries, selling one size as Mocha, another as Java, and another as Santos.

ing historically to notice that a few ye
the American and German market ma
molded from wheat flour, ground peas,
which closely resembled the genuine co

It is in the roasted and ground coffe
adulteration exists, and of this great a
but adulteration is not as common as
common adulterants used are the roo
beets, carrots, etc.; acorns, beans, pea
stones, as well as dried figs, locust bea
and organic coloring matters and pellet
or cereals, molded and roasted. These s
detected by careful inspection and the us

Chicory (see p. 183) has been for so
an adulterant of coffee, and as a consti
and coffee substitutes that it deserves s
of wild endive (Chicorium intybus) of th
and bears a flower something like the
but of a pale blue color. It is extens
Italy, Holland and northern France. Th

The coloring power of chicory is very great,[1] and this is the principal reason for its addition to coffee, as the use of a small quantity makes the infusion appear a dark brown, and apparently very strong. Digestion is more impeded by chicory than by coffee. The constant use of chicory as a beverage may cause injury to the system on account of the great quantity of potassium salts which it contains, and it exhibits no corresponding advantages in the way of stimulating and exhilarating effects on the system.

The sale of the cheap ground coffee is, however, not so much to be condemned on account of its effect on the system as because it is a fraud on the consumer, who often purchases a cheap article at a high price.

Of the 16,000,000 bags of coffee, of 120 pounds each, having a total value of over $200,000,000, produced annually in the world, Brazil frequently furnishes over 10,000,000 bags. The United States is the great coffee consumer of the world. The average consumption here is about 12 pounds per person each year, while that of Holland is 14 pounds, of Germany 6 pounds, and of Great Britain, Australia and Canada only 1 pound. We imported 1,333,564,067 pounds of coffee in 1919.

Coffee Substitutes

The materials already referred to which are used for adulteration of coffee are also used in making coffee substitutes. Some proprietary mixtures are on the market, which are made from bananas, roasted grains, low-grade molasses or "black strap" (see p. 128) and coloring matter. Dandelion is sometimes substituted for chicory, in making mixed coffees or is used directly for making a beverage. Gumbo or okra (see p. 173) figs and acorns are used in a similar way.

Coffee extracts are much in demand, especially in some parts of the Continent. They may be made by digesting coffee and chicory, and evaporating the infusion *in vacuo*. Some of these precontinue to bear fruit for fifty years. It feet in height, with a trunk from 5 to 8 inc flowers and fruit are borne not only on the also on the stem, and the crop is harvested year. (Fig. 91.)

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[1] Grimshaw, Br. Food Jr., II, 3 (Chem. Abst., Vol. 3, p. 1193).

The beans, as they are called, which almonds, are arranged in five rows in the These pods are about 8 inches long and som in shape; although, tapering to the point at gated along the sides.

Preparation of the Be

There are several methods for treat kernels to prepare them for the market. from the shells, and subjected to a process in boxes or holes in the ground. This pr to be removed, and, probably by the action the color and especially the chemical comp beans.

The next process is drying and roastin

broken beans are called "cacao nibs," and from these also by protracted boiling a beverage can be made.

Manufacture of Cocoa and Chocolate

It seems desirable, in order to prepare a more wholesome and satisfactory beverage from the cacao beans, and to open up their tissues so as to render the materials more capable of emulsion and suspension in water or milk, that they should be subjected to some special treatment. Among the processes for the preparation of the so-called "soluble" cocoa, may be noticed the Dutch method, which is either with or without the removal of some of the fat, to treat the powder from the roasted beans with some alkali as potassium or sodium carbonate, and the German method in which ammonia or ammonium carbonate is used.[1] Treatment with alkali is regarded by some with disfavor and as wholly unnecessary.[2]

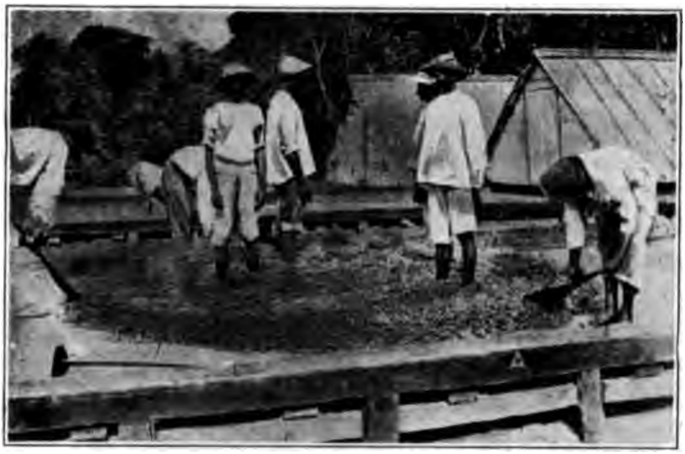

FIG. 92.—"Dancing" cocoa beans. (By permission, World's Commercial Products.)

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[1] Loc. cit., p. 179.

[2] Food Inspection and Analysis, Leach, 4th Ed., p. 418.

lowed to remain in the powder. Exper
ment of powdered cocoa from which th
with a *volatile* alkali, is the best method
The Dept. of Agri., however, consider
plied to this process a misnomer, as no
than by any other process.

In the manufacture of plain or "bit
which have been previously roasted an
warm to a pasty mass in "edge runner
late" is to be made, this cacao mass
sugar, spices, and other flavoring mater
arranged that the mixture can be heate
40° C., a temperature which is rather ab
cacao butter. The flavoring material
cardamon, mace, oil of lemon, or vani
proportion of sugar and the different
stitutes the chief difference between va
late. Frequently a considerable amo
from the ground beans by pressure, be
If more than 60 per cent. of sugar is
added to produce a mass that can

The following is the analysis of some cocoa products:[1]

	Pure cocoa	Cocoa shells	Plain chocolate	Sweet chocolate
Water	6.23	4.87	3.78	2.17
Ash	5.49	10.43	3.15	2.17
Theobromine	1.15	0.49	0.78	0.35
Caffein	0.16	0.16	0.13	0.08
Other nitrogenous substances (protein)	18.34	14.46	12.36	4.58
Crude fiber	4.48	16.55	2.86	0.95
Sugar	0.00	0.00	0.00	56.44
Pure starch	11.14	4.13	8.11	2.88
Other nitrogen-free substances	26.32	46.15	16.64	7.64
Fat	26.69	2.76	52.19	23.51
	100.00	100.00	100.00	100.00

The *fat*, which forms from 36 to 55 per cent. of the bean is a mixture of the glycerides of stearic, palmitic, lauric and arachidic acids (see p. 307), and under the name of "cocoa butter" melting at 86° to 95° F. is of great value in making pharmaceutical preparations and in the manufacture of chocolate candy.

Theobromine, which was discovered in 1841, is an active principle, having the composition ($C_5H_2(CH_3)_2N_4O_2$), a dimethylxanthine. Caffein, the active principle of coffee, is a trimethylxanthine ($C_5H(CH_3)_3N_4O_2$). Theobromine occurs in amount from 1.0 to 2.65 per cent. About half of the nitrogen found in cacao is believed to be amide nitrogen, and consequently not available as a nutrient. The starch adds somewhat to the nutritive value of this product. During the process of roasting it is believed that a peculiar volatile flavoring substance or oil similar to the caffeol of coffee, is developed. Although some of the ***tannin***, which exists in the raw bean, is rapidly oxidized to a "cocoa-red" to which

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[1] Ct. Ag. Ex. Sta.. 1903, Pt. II, p. 125.

regarded as real food.
system is much less than that of tea o
stimulating but more sustaining effect.
some of the cocoas on the market has b
tion of Kola, a practice that should be
valuable beverage for the use of invalid
which it contains interferes with the
usually more liable to produce indige
been used as a part of army rations an
factory as a slightly stimulating and hi

Falsifications and Adu

Cocoa is frequently adulterated
starches. Cocoa shells are sometimes
product, and mineral coloring matter is
understood that the removal of some of
it should contain no *added substances*.

Plain chocolate, according to the
contains not less than 45 per cent. of
been abstracted, this constitutes ad
sugar in the sweet chocolate, or adde

Switzerland and Spain in the order named. Over 392,000,000 pounds was imported into this country in 1919. Of the 551,000,000 pounds of these products produced in 1911, the largest amount came from San Thome and Principe,[1] Ecuador, Brazil, Trinidad, Gold Coast, Dominican Republic and Venezuela. The amount annually consumed in the entire world is increasing very rapidly.

MATÉ, KHAT, KOLA, GUARANA, COCA

Mate or Paraguay tea, a beverage made from the leaves of a species of holly (Ilex Paraguayensis) growing abundantly in Paraguay, Brazil and other South American countries, is very commonly used by the natives. The leaves are dried and slightly roasted and afford a somewhat bitter, aromatic and astringent beverage. They contain caffein, a yellowish essential oil, and only about one-tenth as much tannin as tea. The natives prepare the tea by pouring hot water on the leaves, contained in a gourd, and drink it through a tube called a "bombilla," which is often made of silver, and has a perforated bulb at the end. Maté is the universal drink of more than 15,000,000 people in South America, and the annual crop exported from Paraguay is more than four thousand tons.

Khat, a tea that has been used in Arabia from the earliest times, consists of the leaves of the shrub *Catha edulis*, which grows wild in Abyssinia and is cultivated in Arabia.[2] The leaves of the plant are dried and used for making a decoction which contains an active principle called katin, having stimulating properties similar to caffein.[3]

The **kola** nut is the fruit of the *Sterculia acuminata*, a tall tree growing in Jamaica, on the west cost of Africa, in East India, Ceylon and Brazil. The active principle, called kolanin, is developed by fermentation in the process of curing and under the whether its secondary effects are as narcotics. As a substitute for food or kola is said to sustain the strength fo better than tea or coffee.[1]

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[1] Dept. Commerce and Labor, Spec. Consular Rep. No. 50.

[2] Loc. cit., Tibbles.

[3] Nat. Geog. Mag., April, 1917.

Guarana is a preparation made in American countries from the crushed *Cupana*. It contains from 3.5 per cent. substances mostly caffein, besides tan oil. The product comes into the marke from which pieces are broken and infus refreshing beverage. Guarana acts as enables the traveler to resist hunger marches.

Coca is made from the leaves of t grows in Bolivia, Peru and other part natives chew the leaves. The annual 100,000,000 pounds. The stimulating presence of cocaine ($C_{17}H_{21}NO_4$), ec substances. It produces some excita tion of hunger to disappear. It also for a time without recourse to food.[2]

CHAPTER XX

WATER AND EFFERVESCING BEVERAGES

("Soft Drinks")

Water as an indispensable constituent of foods has already been discussed. The amount of water in foods is always surprising. Upon analysis the vegetables and fruits are found to contain from 70 to 90 per cent. of water. Asparagus, celery, lettuce, pumpkins, cucumbers and melons are all high in water and correspondingly low in food material. The cereals, and legumes, and such tubers as potatoes contain large quantities of water, but not so much as fruits. Fish, meat and game contain from 60 to 80 per cent. of water. As there is a tendency to use an insufficient amount of water or other liquids with the daily diet, this quantity of water in the foods assists greatly in keeping up the fluidity of the food mass as it passes through the body. Recent investigations seem to indicate that water and other liquids taken in quite large quantities with the food tend to assist digestion rather than retard it, as was formerly taught.

Although this large amount of water in the food, as furnished by the plants and animals for sustenance of man, is of value in the processes of digestion, at the same time it renders the food much more liable to spoil, and so very early there arose the practice of drying foods in order to keep them.

WATER AS A BEVERAGE

Water is the basis of all beverages for an examination shows that most of them are simply water flavored with alcohol, vegetable extracts, sugar, acids and fruit ethers, holding in solution

cisterns, it is liable in each individual
On isolated farms or in small villages t
filth near at hand in stables, closets, dra
lows. Few persons appreciate how read
its way from such sources of filth into t
It may percolate through the soil with
tion, or it may run over the surface and
carrying with it any germs of disease t
filth with which it came in contact.
colorless and tasteless it is often consi
remains that some of the most dange
their character by their taste, color or

SOURCES OF SU

Domestic supplies may be obtain
river, pond or lake, or from a shallow (
an artesian well. The rain water may
roof, and stored in a cistern or reservoi

ture and frost. The mineral substances ordinarily found in water include the ions, calcium, magnesium, sodium, potassium, iron, aluminum and a few other metals associated with such acid ions as chlorine, sulfur, and the sulfate, carbonate, nitrate, phosphate, and silicate ions.

Hard and Soft Water

When there is considerable calcium or magnesium salts in the water it is known as a hard water. If this is in the form of carbonate the water is said to be "temporarily hard," while if in the form of sulfates the water is "permanently hard." Chlorides and sulfates of sodium, iron, etc., are also found in permanently hard waters. Much of the calcium and magnesium present in a temporarily hard water is precipitated by boiling, as it is held in solution by the excess of carbon dioxide which is removed by boiling. This accounts for most of the incrustation on the bottom of a tea-kettle or other vessel in which hard water is boiled. If the mineral substances are not too abundant they are not considered particularly injurious. For some culinary purposes, hard water is not satisfactory. For making tea, however, a moderately hard water is preferred. For laundry purposes hard water is very unsatisfactory, as the soap which is added is first used up in precipitating a lime or magnesia soap, before a permanent lather will form. When large amounts of water are prescribed for drinking, the water should be as soft as postible. The diuretic action of large quantities of water is well established. If an abundance of water is taken into the system the tempeature of the body falls and the number of pulsations of the heart and of the inspirations is diminished.

Table Waters

Many of the so-called "table waters" are comparatively free from mineral matter. In the Appalachian and Green Mountain regions of the United States where the rocks are of granite, trap or sandstone, and where there is very little soil through which the

Mineral waters belong to a diff waters, in that they are used for the contain either large quantities of some o or small quantities of some ingredient supposed to have some special therape

Organic Constitu

The organic constituents of waters matter or that which is a product of vegetable or animal origin. These co of vegetable origin, may or may not injurious substances, but they are of sanitarian, because they give some info the water and its history. When wat matter it is liable to contain the germs the water may have been mixed with dra may contain the germs of typhoid fever, that class. The presence of this organi chemist and the bacteriologist that th character; its source is carefully studi ter, the source of the supply should be carefully inspected. If a well, there should be no vault, drain, closet, stable or other source of filth in the vicinity; surface drainage should be fully eliminated by carefully protecting the ground around the well curb by cement or other impervious material. It should not be forgotten that a well is but a "hole in the ground," and as such all near-by filth will be washed into it or percolate through the soil until it reaches this lowest level. When wells, ponds, lakes or rivers are used as a source of *public supply* the character of the water is at the present time carefully tested under the direction of the State or Municipal Boards of Health.

Cistern Water

Cistern water of good quality and safe for domestic use may be obtained in the country and in small towns, from a slate, metallic or well-painted shingle roof, if the first water of a rain is allowed to waste, so as to thoroughly wash off the roof. The water may be filtered through brick or through sand and charcoal, but this filtration should be made as the *water is drawn out of the cistern*, and not as it runs in, as water cannot ordinarily be filtered as rapidly as it falls from the roof. The quality of the water may also be improved by the use of some kind of an aerating pump which carries air into the water whenever water is removed from the cistern.

Use of Domestic Filters

It is a well-known practice to treat an impure water on a large scale with alum or with alum and iron, and filter it through sand, thus rendering the water safe for domestic use. This process cannot however be conveniently applied on a scale small enough for household purposes. Many of the filters recommended by dealers for domestic use simply strain out the coarser impurities, and are of no value to remove disease germs and thus render the water safe. There are on the market filters of the Pasteur type, made from unglazed porcelain or similar material, which practically

considered very unpalatable. D
taste to the absence of dissolved g
waters, and to the absence of th
have become accustomed. This w
rendered more palatable, by being
or this may be done on a large sca
water.

This water is put on the mark
under various trade names. Somet
to the distilled water a few grain
sodium chloride, to improve its tas

ICE

Foods and beverages are cooled
them in cold-storage warehouses, or
to ice. A building, whose walls are
materials, is cooled by passing thro
of the room, a set of pipes through w
Boats used for the transportation o
the same way. At the present time

pand to a gas, absorbs heat from surrounding objects, and thus lowers their temperature. On this account as the liquid ammonia expands in pipes running through a tank of brine, the latter is cooled even below the freezing point of fresh water, so that water placed in metallic boxes and allowed to stand in the brine will after some hours be frozen to a solid cake of ice.

Small ice machines have recently been introduced for family or hotel use. Some of these are quite compact and use liquid carbon dioxide, or liquid sulfur dioxide to cool the brine which is circulated in pipes through the refrigerator or ice chest.

It is a mistake to suppose that because freezing or crystallization is a purifying process, ice made from impure water will be pure and safe for domestic use. A slight purification does no doubt take place, but the water obtained by the melting of such ice is liable to be dangerous. In any case it is a much better practice, in the cooling of water or other beverages to surround the vessel containing the beverage with ice rather than put the ice directly into the liquid.

Artificial ice since it is usually made from distilled water, has the advantage of being free from organic matter that may accompany germs of disease, and so be dangerous to health. There is a growing tendency among dealers to supply their customers with artificial ice rather than natural, even in those countries where a natural ice can be cut and stored in sufficient quantities in the winter.

NATURAL MINERAL WATERS

In some localities a natural mineral water, either slightly or heavily loaded with mineral salts, is bottled directly at the spring and put upon the market. Thus a general demand has arisen for such natural waters as Apollinaris, Vichy, Seltzer, Poland Spring, and the Saratoga waters. Sometimes the carbon dioxide which is given off from the water as it comes from the ground is pumped off, compressed and later used for charging the water

mote greater activity in the alimentary
mineral waters containing large quantities
have been bottled directly at the springs w
loss of ingredients are used, it should only
physician. These ingredients may or ma
the health of the patient. Imitations of na
ficially, and mixtures of salts with directio
have, in great variety, been placed on
62,281,801 gallons of mineral water were
States, and 3,500,000 were imported.

FLAVORED CARBONATED

SODA WATER

On account of the agreeable taste of
attempt was made, more than two centur
artificially. In some of the earlier atte
powders were mixed, as in Seidlitz pow
machines were constructed to generate
have it absorbed in water under pressure.
mal pressure absorbs or dissolves about

be drawn into strong bottles, which previously contain some flavored and sweetened sirup, and thus soda water or "pop" is made. A very ingenious machine has been constructed for filling the bottles with the carbonated water. It is so arranged that the liquid is passed in and the cap is put in place without the loss of pressure of the gas. This has almost worked a revolution in the bottling business, and is a thoroughly sanitary arrangement. A pressure of 120 to 140 pounds per square inch is sometimes used in bottling.

Manufacture of Carbon Dioxide

Carbon dioxide, which is obtained by burning some form of carbon, as coke or charcoal, or as a by-product in the manufacture of lime from limestone; thus $CaCO_3$ heated $=$ $CaO+CO_2$, is at present used extensively instead of the gas made from the action of sulfur acid on limestone. Both in Germany and in the United States most of the carbon dioxide used by the smaller manufacturer of soda water, is liquefied in strong steel cylinders at a pressure of 1800 pounds per square inch, by compression pumps, and is sold to customers by the pound. This is an extremely convenient method of handling the gas as it can be kept in the cylinders until used. To dispense "soda water" it is only necessary to attach this cylinder to a strong vessel containing cold water, and allow the gas to saturate the water under pressure. This carbonated water is then drawn off at the "fountain," into any sirup of the desired flavor.

It has repeatedly been maintained that the pressure given to the water in the manufacture of soda water and pop, would destroy any pathogenic germs that might be present, and so the manufacturer would be justified in using an impure water for this purpose. On the contrary, it has been shown by experiments made by C. C. Young,[1] that this is not the case; distilled water or a safe water is just as necessary in making soda water as for any other beverages.

[1] J Ind. and Eng. Ch., July, 1911.

pasteurized fruit juices, if made carefully
place, will keep satisfactorily. In case pa
such preservatives as benzoic or salicyli
There seems to be little need for the use
products of this class.

For making artificial beverages such a
raspberryade, etc., acidulated sirups, f
essences or extracts, are often used. The
tartaric, citric, phosphoric or acetic, and
to that in the fruit imitated, and should
cheaper acid. As all fruit owes its flavor t
acids and delicate volatile ethers and alde
substances prepared in the laboratory are
the artificial fruit essence. It would be
extract and isolate these compounds from
are made and put on the market under
apple," which is mostly valerianate of
mostly butyrate of ethyl; oil of quince,
ethyl. These essences have an aroma an
the natural product, but they lack the deli

	Chloroform	Nitrous ether	Aldehyde	Acetic ether	Formic ether	Butyric ether	Valerianic ether	Benzoic ether	Oenanthylic ether	Oil of persicot	Sebacic ether	Methyl-salycylic ether	Amyl alcohol
Pineapple	1		1			5							
Melon			2		1	4	5				10		
Strawberry		1		5	1	5						1	
Raspberry		1	1	5	1	1		1	1		1	1	
Gooseberry			1	5				1	1				
Grape	2		2		2				10			1	
Apple	1	1	2	1									
Orange	2		2	5	1	1		1				1	
Pear				5									
Lemon	1	1	2	10									
Black cherry				10				5		2			
Cherry				5				5	1				
Plum			5	5	1	2				4			
Apricot	1					10	5		1				2
Peach			2	5	5	5	5			5	1		2
Currant			1	5				1	1				

	Amyl-acetic ether	Amyl-butyric ether	Amyl-valerianic ether	Oil of lemon	Oil of orange	Saturated alcoholic solutions of				Glycerine
						Tartaric acid	Oxalic acid	Succinic acid	Benzoic acid	
Pineapple		10								3
Melon										3
Strawberry	3	2								2
Raspberry	1	1				5		1		4
Gooseberry						5		1	1	
Grape						5		3		10
Apple			10				1			4
Orange	1				10	1				10
Pear	2									2
Lemon				10		10		1		5
Black cherry							1		2	
Cherry									1	3
Plum										8
Apricot		1				1				4
Peach										5
Currant						5		1	1	

Ordinary cane sugar is generally use
The use of saccharin (p. 44) in the place
cheaper, was formerly a very common
States. The strict enforcement of the Fo
practice to cease, in many localities.

A genuine ginger ale should be simpl
vored with a sweetened extract of ging
much of the "extract of ginger" used for t
"fortified" with capsicum, to give it gr
because there seemed to be a demand for t
yellow anilin dye, to make it more pleasin

In order to produce a foam in thes
some vegetable preparation like soap-bar
has been used, but this practice is forbidd

Fruit Vinegars

Fruit vinegars are made especially f
berries and blackberries. They may be m
the fruit, sugar and vinegar, straining, st
ting away in sterilized bottles. A tablesp

Law such beverages should not contain over 1 per cent. of alcohol. In the United States the sale of any beverage except under definite restrictions containing over one-half of one per cent. of absolute alcohol is forbidden. (See p. 143.)

Among the flavoring materials used are decoctions of hops, nettles, ginger, spruce branches, sassafras, sarsaparilla, birch bark, tartaric acid and lime juice. These beverages are often called "small beer," and belong to the class of "soft" or non-alcoholic drinks. They are frequently named from the principal flavoring substance present. A market has also arisen for various "proprietary" flavors, which are put on the market as " . . . . . .'s root beer," with directions giving the proportions of water, sugar, yeast, and the "flavor" which is required in making the beverage.

Habit Producing Beverages

Coco-cola is the name of a proprietary beverage in common use in the United States. It was formerly believed by many that cocaine (from the cola nut or leaf) was one of the constituents, but this is not the case. Besides flavoring material the principal constituent of importance is caffeine. (See p. 468.) Comparing this beverage with others containing caffeine, J. W. Mallet says, that of caffeine, tea per cup ordinarily contains 2.02 grains; coffee, per cup, 1.74 grains; coca-cola, as ordinarily dispensed, contains 1.21 grains per glass. In regard to the properties of caffeine and the effect on man, Hollingsworth,[1] says: "Small doses of caffeine alkaloid (1 to 4 grains) taken in either pure form or accompanied by small amounts of sirup, do not produce appreciable sleep disturbance except in individual cases. Doses larger than these (6 grains in these experiments) induced marked sleep impairment with some subjects, even though here a few individuals show complete resistance to its effects. The effects are greater when the dose is taken on an empty stomach, or without food, and when it is taken on successive days so as to permit of accumulative effect. The effect of the drug does not seem to depend on age, sex or

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[1] The Psychological Review, Jan., 1912.

APPENDIX

SECTION I

Official Control of Food

Quite a number of years ago, several of the states enacted laws for the purpose of protecting their citizens against inferior articles of food sold in imitation of pure goods. Notable among these may be mentioned Massachusetts, New York, Conn., Ohio and New Jersey.

The larger cities also sought to control the sale of such common articles as milk, butter, and vinegar and protect the people against fraud. The efforts to enact a Federal Law were for several years successfully opposed by various interests, but finally the "Food and Drugs Act of June 30, 1906" was enacted by Congress.

As this act applied only to Food in Interstate Commerce, the individual states have enacted a similar law to control the manufacture and sale of food products within the borders of the States.

A meat Inspection law was passed June 30, 1906 "for the purpose of preventing the use in interstate or foreign commerce . . . of meat and meat-food products which are unsound, unhealthful, unwholesome, or otherwise unfit for human food," and appropriations were made for the pay of Federal Inspectors.

The Food and Drugs Act, known as the National Pure Food Law, as amended August 23, 1912 and March 3, 1913 is as follows:

An act for preventing the manufacture, sale or transportation of adulterated or misbranded or poisonous or deleterious foods, drugs, medicines and liquors, and for regulating traffic therein and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be unlawful for any person to manufacture, sell or offer for sale within any Territory or the District of Columbia, or deliver for shipment, or to cause to be delivered, shipped or transported from within any State, Territory or District of Columbia to any State, Territory or District of Columbia, or foreign country, any article of food, drugs, medicines or liquors which is adulterated or misbranded, or which contains any poisonous or deleterious substance within the meaning of this Act; and any person who shall violate any of the provisions of this section shall be guilty of a misdemeanor, and for each offense

decomposition.
Sixth. If it consists in whole or in part of a filthy, deco
or vegetable substance, or any portion of an animal unfi
putrid, or if it is the product of a diseased anima
wise than by slaughter.

Sec. 8. That the term "misbranded," as used herein,
articles of food, or articles which enter into the composi
or label of which shall bear any statement, design or dev
or the ingredients or substances contained therein shall be
particular, and to any food or drug product which is false
Territory or country in which it is manufactured or prod

That for the purposes of this Act an article also shall be

IN CASE OF DRUGS:

First. If it be an imitation of or offered for sale u
article.

Second. If the contents of the package as origina
removed, in whole or in part, and other contents shall ha
age, or if the package fail to bear a statement on the lab
tion of any alcohol, morphine, opium, cocaine, heroi
chloroform, cannabis indica, chloral hydrate or aceta
preparation of any substances contained therein.

Third. If its package or label shall bear or conta
device regarding the curative or theraupetic effect o
ingredients or substances contained therein, which is f

IN CASE OF FOOD:

First. If it be an imitation of or offered for sale u rules and regulations made in accordance with the provisions of Section three of this Act. That this Act shall take effect and be in force from and after its passage: Provided, however, That no penalty of fine, imprisonment, or confiscation shall be enforced for any violation of its provisions as to domestic products prepared or foreign products imported prior to eighteen months after its passage.

Fourth. If the package containing it or its label shall bear any statement, design or device regarding the ingredients of the substances contained therein, which statement, design or device shall be false or misleading in any particular. *Provided*, That an article of food which does not contain any added poisonous or deleterious ingredients shall not be deemed to be adulterated or misbranded in the following cases:

First. In the case of mixtures or compounds which may be now or from time to time hereafter known as articles of food, under their own distinctive names, and not an imitation of or offered for sale under the distinctive name of another article, if the name be accompanied on the same label or brand with a statement of the place where said article has been manufactured or produced.

Second. In the case of articles labeled, branded or tagged, so as to plainly indicate that they are compounds or blends, and the word "compound," "imitation" or "blend," as the case may be, is plainly stated on the package in which it is offered for sale. *Provided,* That the term blend as used herein shall be construed to mean a mixture of like substances, not exceeding harmless coloring, or flavoring ingredients used for the purpose of coloring and flavoring only. *And provided further*, That nothing in this Act shall be construed as requiring or compelling proprietors or manufacturers of proprietary foods which contain no unwholesome added ingredient to disclose their true formulas, except in so far as the provisions of this Act may require to secure freedom from adulteration or misbranding.

Sec. 9. That no dealer shall be prosecuted under the provisions of this Act when he can establish a guaranty signed by the wholesaler, jobber, manufacturer or other party residing in the United States from whom he purchases such articles to the effect that the same is not adulterated or misbranded within the meaning of this Act, designating it. Said guaranty, to afford protection, shall contain the name and address of the party or parties making the sale of such articles to such dealer, and in such case said party or parties shall be amenable to the prosecutions, fines and other penalties which would attach, in due course, to the dealer under the provisions of this Act.

Sec. 10. That any article of food, drug or liquor that is adulterated or misbranded within the meaning of this Act and is being transported from one State, Territory, District of Columbia or insular possession to another for sale, or having been transported, remains unloaded, unsold, or in original unbroken packages, or if it be sold or offered for sale in the District of Columbia, or in the Territories or insular possessions of the United States; or if it be imported from a foreign country for sale, or if it is intended for export to a foreign country, shall be liable to be proceeded against in any district court of the United States within the District where the same is found and seized for confiscation by a process of libel for condemnation. And if such article is condemned as being adulterated or misbranded, or of a poisonous or deleterious character, within the meaning of this Act, the same shall be disposed of by destruction or sale, as the said court may direct, and the proceeds there-

Sec. 11. The Secretary of the Treasury shall delive culture, upon his request from time to time, samples are being imported into the United States or offered for i to the owner or consignee, who may appear before the S have the right to introduce testimony, and if it appea such samples that any article of food or drug offered to b States is adulterated or misbranded within the meaning dangerous to the health of the people of the United Stat entry into or forbidden to be sold or restricted in sale i made or from which it is exported, or is otherwise fal the said article shall be refused admission, and the Sec refuse delivery to the consignee and shall cause the dest delivery which shall not be exported by the consignee w date of notice of such refusal under such regulations as t may prescribe. *Provided,* That the Secretary of the T consignee such goods pending the examination and deci tion of a penal bond for the amount of the full invoice v with the duty thereon, and on refusal to return such custody of the Secretary of the Treasury, when dema cluding them from the country, or for any other purpos the full amount of the bond. *And provided further,* T cartage and labor on goods which are refused admission the owner or consignee, and in default of such pay against any future importation made by such owner or

Sec. 12. That the term "Territory" as used in this possessions of the United States. The word "person" construed to impart both the plural and singular, as t

SECTION II

Reference has already been made to the use of the "Calorie" (p. 23) as a unit of energy. Since it may be found convenient in the calculation of Dietaries to have the percentage composition and fuel value or calories of the common foods grouped together for reference, the following tables are here appended. The most convenient method of calculation is to determine how many calories a given weight will furnish. The latest determinations show that one gram of dry protein will furnish 4.1 calories; a gram of a carbohydrate 4.1 calories; and a gram of fat 9.3 calories. The percentages of the different nutrients in the tables which follow may be multiplied by the figures given above, and the results added give the calories in a hundred grams of the food.

Chemical Composition of American Food Materials

In order to facilitate the work of the dietary student the following arrangement of subjects has been made. Most of the figures have been taken from Bulletin 28 (revised), U. S. Department of Agriculture. More complete tables and a different arrangement of materials may be found in the "Laboratory Manual of Dietetics," M. S. Rose, and in "Principles of Human Nutrition," W. H. Jordan.

COMPOSITION OF VEGETABLE FOODS

Cereal Products.
Sugar and Starch Products.
Vegetables, Roots, Legumes, etc.
Fruits, Berries, etc.
Nuts and Vegetable Oils.

COMPOSITION OF ANIMAL FOODS

Meats.
Fish, Mullusks, Crustaceans, etc.
Dairy Products and Eggs.

Corn meal		
Corn flour	7.1	1.3
Pop corn	10.7	5.0
Hominy	8.3	0.6
Kafir corn	6.6	3.8
Oat meal	16.1	7.2
Rice	8.0	0.3
Rye flour	6.8	0.9
Wheat flour, entire	13.8	1.9
Wheat flour, graham	13.3	2.2
Wheat flour, roller process, bakers	13.3	1.5
Wheat flour, roller process, family and straight patent	10.8	1.1
Spaghetti	12.1	0.4
Macaroni	13.4	0.9
Vermicelli	10.9	2.0
Noodles	11.7	1.0
Bread, corn	7.5	4.7
Bread, brown	5.4	1.8
Bread, rye	9.0	0.6
Bread, wheat, home-made	9.1	1.6
Bread, wheat, average	9.3	1.2
Bread, wheat, graham	8.9	1.8
Bread, wheat, toasted	11.5	1.6
Crackers, soda	9.8	9.1
Yeast (compressed)	11.7	0.4
Shredded wheat	10.6	1.4
Grape nuts	11.5	1.0
Force	10.0	1.5
Corn flakes	5.5	1.5
Cracked wheat	11.1	1.7

SUGAR AND STARCH PRO

VEGETABLES, ROOTS, LEGUMES, ETC.

	Protein, per cent.	Fat, per cent.	Carbo-hydrates, per cent.	Ash, per cent.	Fuel value, per pound, calories
Artichokes (Jerusalem)	2.6	0.2	16.7	1.0	365
Asparagus, canned	1.5	0.1	2.8	1.2	85
Asparagus	1.8	0.2	3.3	0.7	105
Beans, string, A.P.[1]	2.1	0.3	6.9	0.7	180
Beans, string, canned	1.1	0.1	3.8	1.3	95
Beans, butter, green, E.P.[1]	9.4	0.6	29.1	2.0	740
Beans, butter, green, A.P	4.7	0.3	14.6	1.0	370
Beans, dried	22.5	1.8	59.6	3.5	1,605
Beans, lima, green, E.P	7.1	0.7	22.0	1.7	570
Beans, lima, green, A.P	3.2	0.3	9.9	0.8	255
Beans, lima, dried	18.1	1.5	65.9	4.1	1,625
Beans, baked	6.9	2.5	19.6	2.1	600
Beans, soy	34.0	16.8	33.7	4.7	1,970
Beets	1.6	0.1	9.7	1.1	215
Cabbage, A.P	1.4	0.2	4.8	0.9	125
Sauerkraut	1.7	0.5	3.8	5.2	125
Carrots, E.P	1.1	0.4	9.3	1.0	210
Carrots, A.P	0.9	0.2	7.4	0.9	160
Catsup, Tomato	1.5	0.2	12.3	3.2	265
Cauliflower, A.P	1.8	0.5	4.7	0.7	140
Celery, E.P	1.1	0.1	3.3	1.0	85
Corn, green, E.P	3.1	1.1	19.7	0.7	471
Corn, green, A,P	1.2	0.4	7.7	0.3	180
Corn, green, canned	2.8	1.2	19.0	0.9	455
Cucumbers	0.8	0.2	3.1	0.5	80
Egg plant, E.P	1.2	0.3	5.1	0.5	130
Greens, beet, cooked	2.2	3.4	3.2	1.7	245
Lentils, dried	25.7	1.0	59.2	5.7	1,620
Lettuce, E.P	1.2	0.3	2.9	0.9	90
Mushrooms	3.5	0.4	6.8	1.2	210
Okra, A.P	1.4	0.2	6.5	0.5	155
Onioni, E.P	1.6	0.3	9.9	0.6	225
Onions, A.P	1.4	0.3	8.9	0.5	205
Parsnips, E.P	1.6	0.5	13.5	1.4	300
Parsnips, A.P	1.3	0.4	10.8	1.1	240
Peas, green, E.P	7.0	0.5	16.9	1.0	465
Peas, green, A.P	3.6	0.2	9.8	0.6	255
Peas, dried	24.6	1.0	62.0	2.9	1,655
Cowpeas,, dried	21.4	1.4	60.8	3.4	1,590
Peas, green, canned	3.6	0.2	9.8	1.1	255
Peanuts, A.P	25.8	38.6	24.4	2.0	2,560
Peanut butter	29.3	46.5	17.1	5.0	2,825
Potatoes, E.P	2.2	0.1	18.4	1.0	385

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[1] N.B. E.P.(Edible portion) refers to the food without seeds, skins, shells, etc. A.P. (As purchased) refers to the food as purchased, with the above inedible portions retained.

	Per cent.	Per cent.	Per
Almonds	64.8	35.2	
Brazil nuts	49.6	50.4	
Filberts	52.1	47.9	1
Hickory nuts	62.2	37.8	1
Pecans	53.2	46.8	3
English walnuts	58.0	42.0	2
Chestnuts, fresh	16.0	84.0	45.
Chestnuts, dried	24.0	76.0	5.
Acorns	35.6	64.4	4.
Beechnuts	40.8	59.2	4.
Butternuts	86.4	13.6	4.
Walnuts	74.1	25.9	2.
Coconut	48.8	51.2	14.1
Coconut, shredded		100.0	3.5
Pistachio, kernels		100.0	4.2
Pine nut or piñon (*Pinus edulis*)	40.6	59.4	3.4
Peanuts, raw	24.5	75.5	9.2
Peanuts, roasted	32.6	67.4	1.6
Litchi nuts	41.6	58.4	17.9
Beefsteak	12.8	87.2	61.9
Wheat flour		100.0	12.8
Potatoes	20.0	80.0	78.3
Chocolate, E.P.			10.3
Cocoa, E.P.			4.6
Olive oil			
Corn oil			
Gelatin			

TABLE SHOWING THE CHEMICAL COMPOSITION AND FUEL VALUE PER POUND OF MEATS

Kind and cut of meat	Refuse	Water	Nutrients					Fuel value per pound
			Water-free substance	Protein	Fat	Carbohydrates	Ash	
BEEF	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Calories
Brisket:								
Edible portion	....	47.4	52.6	14.6	37.2	......	0.8	1840
As purchased	14.3	40.6	45.1	12.5	31.9	......	0.7	1580
Chuck, with shoulder								
Edible portion	....	67.8	32.2	19.0	12.3	......	0.9	870
As purchased	17.0	56.3	26.7	15.7	10.2	......	0.8	720
Chuck ribs:								
Edible portion	....	57.3	42.7	17.4	24.4	......	0.9	1355
As purchased	13.8	49.3	36.9	15.0	21.1	......	0.8	1170
Flank:								
Edible portion	....	59.3	40.7	17.6	22.2	......	0.9	1260
As purchased	6.6	55.5	37.9	16.5	20.6	......	0.8	1175
Loin:								
Edible portion	....	60.5	39.5	18.3	20.2	......	1.0	1190
As purchased	13.0	52.6	34.4	15.9	17.6	......	0.9	1040
Neck:								
Edible portion	....	63.4	36.6	19.2	16.5	......	0.9	1055
As purchased	27.6	45.9	26.5	13.9	11.9	......	0.7	760
Plate:								
Edible portion	....	52.7	47.3	15.4	31.1	......	0.8	1600
As purchased	14.7	44.9	40.4	13.1	26.6	......	0.7	1365
Ribs:								
Edible portion	....	55.4	44.6	16.9	26.8	......	0.9	1445
As purchased	20.8	43.8	35.4	13.4	21.3	......	0.7	1150
Ribs, cross:								
Edible portion	....	43.9	56.1	13.7	41.6	......	0.8	2010
As purchased	12.2	38.6	49.2	12.0	36.5	......	0.7	1765
Round:								
Edible portion	....	65.8	34.2	19.7	13.5	......	1.0	935
As purchased	7.7	60.7	31.6	18.1	12.6	......	0.9	870
Round, second cut:								
Edible portion	....	69.5	30.5	20.6	8.6	......	1.3	745
As purchased	32.1	47.2	20.7	14.0	5.8	......	0.9	505
Rump:								
Edible portion	....	56.7	43.3	16.8	25.6	......	0.9	1395
As purchased	21.4	44.5	34.1	13.2	20.2	......	0.7	1095
Shank, fore:								
Edible portion	....	67.9	32.1	19.6	11.6	......	0.9	855
As purchased	36.9	42.9	20.2	12.3	7.3	......	0.6	535
ank, hind:								
Edible portion	....	67.8	32.2	19.8	11.5	......	0.9	855
As purchased	53.9	31.3	14.8	9.1	5.3	......	0.4	395
Shoulder and clod:[1]								
Edible portion	....	68.3	31.7	19.3	11.3	......	1.1	835
As purchased	16.4	56.8	26.8	16.1	9.8	......	0.9	715

[1] The clod itself has no bone—*i.e.*, refuse.

BEEF	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Fore quarter:					
Edible portion		61.4	38.6	17.5	20.2
As purchased	19.4	49.5	31.1	14.1	16.3
Hind quarter:					
Edible portion		61.0	39.0	18.0	20.1
As purchased	15.8	51.3	32.9	15.2	17.0
Side:					
Edible portion		60.6	39.4	17.7	20.8
As purchased	18.3	49.7	32.0	14.5	16.8
Liver, as purchased		69.8	30.2	21.6	5.4
Cooked, corned, and canned, as purchased		53.1	46.9	28.5	14.0
Corned brisket:					
Edible portion		50.9	49.1	18.7	24.7
As purchased	21.4	40.0	38.6	14.7	19.4
Corned flank:					
Edible portion		49.9	50.1	14.2	33.
As purchased	12.1	43.7	44.2	12.4	29.
Corned plate:					
Edible portion		40.1	59.9	13.3	41.
As purchased	14.5	34.3	51.2	11.4	35.
Corned rump:					
Edible portion		58.1	41.9	15.3	23.
As purchased	6.0	54.5	39.5	14.4	22.
Dried and smoked, as purchased		50.8	49.2	31.8	6.
Tongue:					
Canned, whole, as purchased		51.3	78.7	21.5	23
Canned, ground, as purchased		49.9	50.1	21.0	25
Pickled, as purchased		62.3	37.7	12.5	20

TABLE SHOWING THE CHEMICAL COMPOSITION AND FUEL VALUE PER POUND OF MEATS—(*Continued*)

Kind and cut of meat	Refuse	Water	Nutrients					Fuel value per pound
			Water-free substance	Protein	Fat	Carbohydrates	Ash	
VEAL								
Loin:	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Calories
Edible portion	....	69.2	30.8	19.4	10.4	......	1.0	800
As purchased	17.3	57.2	25.5	16.0	8.6	......	0.9	660
Neck:								
Edible portion	....	72.6	27.4	19.5	6.9	......	1.0	655
As purchased	31.5	49.9	18.6	13.3	4.6	......	0.7	440
Rib:								
Edible portion	....	72.5	27.5	20.2	6.2	......	1.1	635
As purchased	26.9	53.0	20.1	14.7	4.6	......	0.8	470
Rump:								
Edible portion	....	62.6	37.4	20.1	16.2	......	1.1	1055
As purchased	30.2	43.7	26.1	14.0	11.3	......	0.8	735
Shank, fore:								
Edible portion	....	74.0	26.0	19.8	5.2	......	1.0	590
As purchased	40.4	44.1	15.5	11.8	3.1	......	0.6	350
Shank, hind:								
Edible portion	....	74.5	25.5	19.9	4.6	......	1.0	565
As purchased	62.7	27.8	9.5	7.4	1.7	......	0.4	210
Fore quarter:								
Edible portion	....	71.7	28.3	19.4	8.0	......	0.9	700
As purchased	24.5	54.2	21.3	14.6	6.0	......	0.7	525
Hind quarter:								
Edible portion	....	70.9	29.1	19.8	8.3	......	1.0	720
As purchased	20.7	56.2	23.1	15.7	6.6	......	0.8	570
Side:								
Edible portion	....	71.3	28.7	19.6	8.1	......	1.0	705
As purchased	22.6	55.2	22.2	15.1	6.3	......	0.8	545
Liver, as purchased	....	73.1	26.9	20.4	5.3	......	1.2	605
LAMB								
Breast:								
Edible portion	....	56.2	43.8	19.2	23.6	......	1.0	1355
As purchased	19.1	45.5	35.4	15.5	19.1	......	0.8	1095
Leg, hind:								
Edible portion	....	63.9	36.1	18.5	16.5	......	1.1	1040
As purchased	17.4	52.9	29.7	15.2	13.6	......	0.9	855
Loin:								
Edible portion	....	53.1	46.9	17.6	28.3	......	1.0	1520
As purchased	14.8	45.3	39.9	15.0	24.1	......	0.8	1295
Neck:								
Edible portion	....	56.7	43.3	17.5	24.8	......	1.0	1375
As purchased	17.7	46.7	35.6	14.4	20.4	......	0.8	1130
Shoulder:								
Edible portion	....	51.8	48.2	17.5	29.7	......	1.0	1580
As purchased	20.3	41.3	38.4	14.0	23.6	......	0.8	1255

Edible portion........					
As purchased..........	21.3	39.9	38.8	11.3	
Flank, as purchased......	....	45.8	54.2	14.8	38.
Leg, hind:					
Edible portion........	....	62.8	37.2	18.2	18.
As purchased..........	18.0	51.4	30.6	14.9	14.
Loin:					
Edible portion........	....	50.1	49.9	15.9	33.
As purchased..........	15.3	42.2	42.5	13.2	28.
Neck:					
Edible portion........	....	58.2	41.8	16.3	24.
As purchased..........	28.4	41.6	30.0	11.7	17.
Shoulder:					
Edible portion........	....	61.9	38.1	17.3	19.
As purchased..........	21.7	48.5	29.8	13.5	15.
Fore quarter:					
Edible portion........	....	51.7	48.3	15.0	32.
As purchased..........	21.1	40.6	38.3	11.9	25.
Hind quarter:					
Edible portion........	....	54.8	45.2	16.2	28
As purchased..........	16.7	45.6	37.7	13.5	23
Side, without tallow:					
Edible portion........	....	53.1	46.9	15.4	30
As purchased..........	19.2	42.9	37.9	12.5	24
PORK					
Chuck and shoulder:					
Edible portion........	....	51.1	48.9	16.9	3
As purchased..........	18.1	41.8	40.1	13.8	2
Flank:					
Edible portion........	....	59.0	41.0	17.8	2
As purchased[1].........	71.2	17.0	11.8	5.1	
Loin:					
Edible portion........	....	52.0	48.0	16.8	
As purchased..........	15.8	43.8	40.4	14.1	

TABLE SHOWING THE CHEMICAL COMPOSITION AND FUEL VALU PER POUND OF MEATS—(*Continued*)

Kind and cut of meat	Refuse	Water	Nutrients					Fuel value per pound
			Water-free substance	Protein	Fat	Carbohydrates	Ash	
PORK			Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	
Shoulder, smoked:	Per cent.	Per cent.						Calories
Edible portion	....	46.8	53.2	15.5	33.3	......	4.4	1695
As purchased	15.4	39.8	44.8	13.1	28.1	......	3.6	1430
Salt, clear fat, as purchased	....	7.3	92.7	1.8	87.2	......	3.7	3715
Salt, lean ends:								
Edible portion	....	19.9	80.1	7.3	67.1	......	5.7	2965
As purchased	11.2	17.6	71.2	6.5	59.6	......	5.1	2635
Bacon, smoked:								
Edible portion	....	18.2	81.8	10.0	67.2	......	4.6	3020
As purchased	8.0	16.8	75.2	9.2	61.8	......	4.2	2780
Feet:								
Edible portion	....	68.2	31.8	16.1	14.8	......	0.9	925
As purchased	35.5	44.6	19.9	10.0	9.3	......	0.6	580
Ham, deviled, canned, as purchased	....	45.3	54.7	18.9	32.9	......	2.9	1740
Side: Edible portion	....	29.4	70.6	8.5	61.7	......	0.4	2760
As purchased	11.2	26.1	62.7	7.5	54.8	......	0.4	2455
SAUSAGE								
Bologna: Edible portion	....	59.5	40.5	18.6	18.2	0.1	3.6	1115
As purchased[1]	3.3	55.2	41.5	18.0	19.7	......	3.8	1165
Frankfort, as purchased	....	55.5	44.5	21.7	18.8	0.4	3.6	1205
Pork, as purchased	....	38.7	61.3	12.8	45.4	0.8	2.3	2155
Tongue, as purchased	....	46.4	53.6	17.3	33.1	......	3.2	1720
SOUPS, CANNED								
Bouillon, as purchased	....	96.5	3.5	2.0	0.1	0.2	1.2	45
Chicken, as purchased	....	93.8	6.2	3.6	0.1	1.5	1.0	100
Consommé, as purchased	....	96.0	4.0	2.5	......	0.4	1.1	55
Mock turtle, as purchased	....	89.8	10.2	5.2	0.9	2.8	1.3	185
Ox tail, as purchased	....	88.8	11.2	4.0	1.3	4.3	1.6	210
Tomato, as purchased	....	90.0	10.0	1.8	1.1	5.6	1.5	185
POULTRY								
Chicken: Edible portion	....	74.2	25.8	22.8	1.8	......	1.2	500
As purchased	34.8	48.5	16.7	14.8	1.1	......	0.8	325
Fowl:								
Edible portion	....	66.3	33.7	18.2	14.4	......	2.1	945
As purchased	30.0	46.5	23.5	12.5	10.2	......	0.8	665
Goose:								
Edible portion	....	42.3	57.7	13.0	43.9	......	0.8	2095
As purchased	22.2	33.1	44.7	10.3	33.8	......	0.6	1620
Turkey:								
Edible portion	....	55.5	44.5	20.6	22.9	......	1.0	1350
As purchased	22.7	42.4	34.9	15.7	18.4	......	0.8	1070
Chicken, canned, as purchased	....	46.9	53.1	20.5	30.0	......	2.6	1645
Quail, canned, as purchased	....	66.9	33.1	21.8	8.0	1.7	1.6	775
Turkey, canned, as purchased	....	47.4	52.6	20.7	29.2	......	2.7	1400

[1] Refuse, case.

Alewife, whole						
Bass, large-mouthed black, dressed	46.7	.....	41.9	10.3	0.5	.
Bass, large-mouthed black, whole	56.0	.....	34.6	8.5	0.4	.
Bass, small-mouthed black, dressed	46.4	....	40.1	11.5	1.3	.
Bass, small-mouthed black, whole	53.6	.....	34.7	10.0	1.1	.
Bass, sea, dressed	46.8	.....	42.2	10.1	0.2	.
Bass, sea, whole	56.1	.....	34.8	8.3	0.2	.
Bass, striped, dressed	51.2	.....	37.4	8.7	2.2	.
Blackfish, dressed	55.7	.....	35.0	8.3	0.5	.
Bluefish, dressed	48.6	.....	40.3	9.8	0.6	.
Butterfish, dressed	34.6	.....	45.8	11.7	7.2	.
Butterfish, whole	42.8	.....	40.1	10.2	6.3	.
Carp (European analysis)	37.1	.....	48.4	12.9	0.7	.
Cod, dressed	29.9	.....	58.5	10.6	0.2	.
Cod, steaks	9.2	.....	72.4	16.9	0.5	.
Cusk, dressed	40.3	.....	49.0	10.1	0.1	.
Eel, salt-water, dressed	20.2	.....	57.2	14.6	7.2	.
Flounder, common, dressed	57.0	.....	35.8	6.3	0.3	.
Flounder, winter, dressed	56.2	.....	37.0	6.1	0.2	.
Hake, dressed	52.5	.....	39.5	7.2	0.3	.
Haddock, dressed	51.0	.....	40.0	8.2	0.2	.
Halibut, dressed	17.7	.....	61.9	15.1	4.4	.
Herring, whole	46.0	.....	37.3	10.0	5.9	
Mackerel, dressed	40.7	.....	43.7	11.4	3.5	
Mackerel, Spanish, dressed	24.4	.....	51.4	15.8	7.2	
Mackerel, Spanish, whole	34.6	.....	44.5	13.7	6.2	
Mullet, dressed	49.0	.....	38.2	9.8	2.4	
Mullet, whole	57.9	.....	31.5	8.1	2.0	
Perch, white, dressed	54.6	.....	34.4	8.7	1.8	
Perch, white, whole	62.5	.....	28.4	7.2	1.5	
Perch, yellow, dressed	35.1	.....	50.7	12.6	0.7	
Pickerel, dressed	35.9	.....	51.1	11.9	0.2	
Pickerel, whole	47.1	.....	42.2	9.8	0.2	
Pike, dressed	30.5	.....	55.4	13.0	0.4	
Pike, whole	42.7	.....	45.7	10.7	0.3	
Pollock, dressed	28.5	.....	54.3	15.5	0.6	
Pompano, dressed	45.5	.....	39.5	10.2	4.3	
Porgy, dressed	53.7	.....	34.6	8.6	2.4	
Porgy, whole	60.0	.....	29.9	7.4	2.1	
Red grouper, dressed	55.9	.....	35.0	8.4	0.	
Red snapper, dressed	48.9	.....	40.3	9.6	0.	
[illegible] (sections)	5.2	.....	60.3	16.5	17.	

COMPOSITION OF FISH, MOLLUSKS, CRUSTACEANS, ETC.—(*Continued*)

Kind of food material	Refuse (bone skin, etc.)	Salt	Water	Protein	Fats	Carbohydrates	Mineral matter	Total nutrients	Fuel value per pound
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Calories
PRESERVED FISH									
Mackerel, "No. 1," salted	33.3	7.1	28.1	14.7	15.1	.....	1.7	31.5	910
Cod, salted and dried	24.9	17.2	40.3	16.0	0.4	.....	1.2	17.6	315
Cod, "boneless codfish," salted and dried	......	21.5	54.4	22.1	0.3	.....	1.7	24.1	425
Caviare	......	.....	38.1	30.0	19.7	7.6	[1]4.6	61.9	1530
Herring, salted, smoked, and dried	44.4	6.5	19.2	20.2	8.8	.....	0.9	29.9	45
Haddock, "Finnan-haddock," salted, smoked, and dried	32.2	1.4	49.2	16.1	0.1	.....	1.0	17.2	305
Halibut, salted, smoked, and dried	6.9	12.1	46.0	19.1	14.0	.....	1.9	35.0	945
Sardines, canned	5.0	.....	53.6	24.0	12.1	.....	5.3	41.4	955
Salmon, canned	3.9	1.0	59.3	19.3	15.3	.....	1.2	35.8	1005
Mackerel, canned	......	1.9	68.2	19.9	8.7	.....	1.3	29.9	735
Mackerel, salt, canned	19.7	8.3	34.8	13.8	21.3	.....	2.1	37.2	1155
Tunny (horse mackerel), canned	......	.....	72.7	21.5	4.1	.....	1.7	27.3	575
Haddock, smoked, canned	......	5.6	68.7	21.8	2.3	.....	1.6	25.7	505
MOLLUSKS									
Oysters, solids	......	.....	88.3	6.1	1.4	3.3	0.9	11.7	235
Oysters, in shell	82.3	.....	15.4	1.1	0.2	0.6	0.4	2.3	40
Oysters, canned	......	.....	85.3	7.4	2.1	3.9	1.3	14.7	300
Scallops	......	.....	80.3	14.7	0.2	3.4	1.4	19.7	345
Long clams, in shell	43.6	.....	48.4	4.8	0.6	1.1	1.5	8.0	135
Long clams, canned	......	.....	84.5	9.0	1.3	2.9	2.3	15.5	275
Round clams, removed from shell	......	.....	80.8	10.6	1.1	5.2	2.3	19.2	340
Round clams, in shell	68.3	.....	27.3	2.1	0.1	1.3	0.9	4.4	65
Round clams, canned	......	.....	83.0	10.4	0.8	3.0	2.8	17.0	285
Mussels	49.3	.....	42.7	4.4	0.5	2.1	1.0	8.0	140
General average of mollusks (exclusive of canned)	60.2	.....	34.0	3.2	0.4	1.3	0.9	5.8	100
CRUSTACEANS									
Lobster, in shell	62.1	.....	31.1	5.5	0.7	.....	0.6	6.8	130
Lobster, canned	......	.....	77.8	18.1	1.1	0.6	2.4	22.2	395
Crawfish, in shell	87.7	.....	10.0	2.0	0.1	0.1	0.1	2.3	45
Crab, in shell	55.8	.....	34.1	7.3	0.9	0.5	1.4	10.1	185
Crab, canned	......	.....	80.0	15.8	1.5	0.8	1.9	20.0	370
Shrimp, canned	......	.....	70.8	25.4	1.0	0.2	2.6	29.2	520
General average of crustaceans (exclusive of canned)	73.7	.....	20.9	4.3	0.4	0.2	0.5	5.4	100
TERRAPIN, TURTLE, ETC.									
Terrapin, in shell	79.0	.....	15.6	4.5	0.7	.....	0.2	5.4	115
Green turtle, in shell	76.0	.....	19.1	4.5	0.1	.....	0.3	4.9	90
Average of turtle and terrapin	77.5	.....	17.4	4.2	0.7	.....	0.2	5.1	105
Frogs' legs	32.0	.....	57.0	10.2	0.1	.....	0.7	11.0	210
General average of fish, mollusks crustaceans, etc.	44.0	.....	42.5	10.0	2.5	0.1	0.9	13.5	205

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[1] Including salt.

DAIRY PRODUCTS AND EGGS

	Protein, per cent.	Fat, per cent.	Ca hyd per
Butter	1.0	85.0	...
Buttermilk	3.0	0.5	
Cheese, cottage	20.9	1.0	
Cheese, American, pale	28.8	35.9	
Cheese, Cheddar	27.7	36.8	
Cheese, Cheshire	26.9	30.7	
Cheese, full cream	25.9	33.7	
Cheese, Limburger	23.0	29.4	
Cheese, Neuchatel	18.7	27.4	
Cheese, Roquefort	22.6	29.5	
Cheese, skimmed milk	31.5	16.4	
Cheese, Swiss	27.6	34.9	
Cream	2.5	18.4	
Koumiss	2.8	2.1	
Milk, whole	3.3	4.0	
Milk, skimmed	3.4	0.3	
Milk, condensed, sweetened	8.8	8.3	
Milk, condensed, evaporated	9.6	9.3	
Whey	1.0	0.3	
Oleomargarine	1.2	83.0	
Eggs, hens', E.P.	13.4	10.5	
Eggs, hens', A.P.	11.9	9.3	
Eggs, hens', boiled whites	12.3	0.2	
[illegible]	15.7	33.3	

SECTION III

Common Food Values

This table, compiled by Dr. E. A. Locke (see "Food Value will be found convenient for the purpose of estimating the f value of an ordinary meal from the "portions" usually serve

To determine percentage composition from this table, in case where this is desired, determine the amount for 100 gra when that is not the amount given, and the figures obtained represent percentage composition. In a similar way the t calories in 100 grams can be obtained.

COMMON FOOD VALUES

Foodstuffs	Quantity	Weight, grams	Protein, grams	Fats, grams	Carbohydrates
Beef juice	4 ounces	120	5.88	0.72	....
Corned beef hash	2 heaping tablespoons	100	6.00	1.90	9.40
Roast beef	1 slice	100	22.30	28.60	....
Steak, tenderloin beef	1 slice	100	23.50	20.40	....
Sweetbreads, 2	....	80	32.00	0.45	....
Creamed chicken on toast	2 heaping tablespoons	125	16.26	12.62	21.76
Roast chicken	1 slice	100	32.10	4.40	2.10
Lamb chop with bone	1 chop	100	21.70	29.90	....
Roast lamb	1 slice	75	14.78	9.53	....
Boiled mutton, lean	1 slice	75	23.18	3.38	....
Mutton chop, lean	1 chop	100	22.60	4.50	....
Mutton, roast leg	1 slice	75	18.75	16.95	....
Ham, smoked, boiled, as purchased	1 slice	33	7.29	6.80	....
Ham, smoked, fried	1 slice	35	7.77	11.62	....
Roast turkey	1 slice	100	27.80	18.40	....
Veal cutlet	1 cutlet	80	22.82	1.14	....
Veal roast	1 slice	75	21.33	1.00	....
Bluefish	Average helping	100	25.90	4.50	....
Codfish	Average helping	100	21.68	0.27	1.58
Halibut	Average helping	100	20.35	4.04	....
Mackerel	Average helping	70	11.73	4.84	2.62
Salmon	Average helping	100	19.65	10.21	5.36
Sardines, canned	1 fish	10	2.30	1.97	....
Clams, round	6 clams	100	6.50	0.4	4.20
Crabs, hard shelled, as purchased	1 crab	245	19.36	2.21	1.47
Oysters	6 oysters	85	5.27	1.02	3.15
Oyster stew	4 ounces	124	6.07	11.06	10.53
Scalloped oysters	6 large oysters	138	8.06	18.58	11.98
Scallops, fried	3 heaping tablespoons	110	28.20	1.75	6.02
Bean soup, home-made	Teacup	120	3.84	1.68	11.28

Chicken gumbo soup, canned..			
Consommé, canned..........	Teacup	120	[illegible]
Asparagus cream soup.......	Teacup	125	3.44
Celery cream soup...........	Teacup	125	3.00
Corn cream soup............	Teacup	125	3.75
Pea cream soup.	Teacup	125	6.29
Tomato cream soup..........	Teacup	125	2.99
Oxtail soup, canned..........	Teacup	120	4.80
Vegetable soup, canned......	Teacup	120	3.48
Butter.....................	1 ball	15	0.15
Average cream..............	1 tablespoon	20	0.74
American cheese, pale........	1 cubic inch	20	5.70
Fromage de Brie............	1 cubic inch	20	3.18
Full cream cheese............	1 cubic inch	20	5.18
Roquefort cheese............	1 cubic inch	20	4.52
Swiss cheese................	1 slice	20	5.52
Buttermilk..................	1 glass	218	6.5
Whole milk..................	1 glass	220	7.2
Whey......................	1 glass	203	2.0
Hen's eggs, boiled...........	1 egg	50	6.6
Omelette, egg...............	1/2 omelette	75	9.8
Ingredients:			
3 tablespoons milk, 3 eggs, 1 heaping teaspoon butter.			
Asparagus, canned..........	....	125	1.
Baked beans, home-made.....	3 heaping tablespoons	150	10.
Butter beans................	4 heaping tablespoons	180	63.
Lima beans..................	2 heaping tablespoons	80	6.
String beans.................	2 heaping tablespoons	60	0.
Beets......................	2 heaping tablespoons	70	1.
Cabbage....................	3 heaping tablespoons	100	0
Carrots.....................	3 heaping tablespoons	100	0
Cauliflower..................	2 heaping tablespoons	120	1
Celery, uncooked............	3 small stalks	55	0
	2 heaping tablespoons	100	2

COMMON FOOD VALUES—(*Continued*)

Foodstuffs	Quantity	Weight, grams	Protein, grams	Fats, grams	Carbohydrates	Total calories
Turnips	2 heaping tablespoons	140	0.45	0.08	0.91	6
Apple	Average size	150	0.45	0.45	16.22	72
Banana	Average size	194	1.55	0.78	27.74	127
Blackberries	3 heaping tablespoons	100	1.30	1.00	10.90	59
Cantaloupe	1 /2 melon	465	1.40	....	21.39	93
Cherries	About 1 /2 pound	100	0.90	0.80	15.90	76
Currants	4 heaping tablespoons	100	1.50	....	12.80	59
Grapefruit	1/2 large	300	2.37	0.60	30.27	139
Grapes	1 bunch	150	1.50	1.80	21.60	112
Gooseberries	4 heaping tablespoons	90	0.90	......	11.79	52
Huckleberries	4 heaping tablespoons	100	0.60	0.60	16.60	76
Orange	Average size	250	1.50	0.25	21.25	96
Peach	Average size	128	0.64	0.13	9.86	44
Pear	Average size	156	0.78	0.62	19.81	90
Pineapple, edible portion	2 slices	100	0.40	0.30	9.70	44
Plum	Average size	35	0.32	....	6.69	29.
Raspberries	3 heaping tablespoons	82	0.82	....	10.33	46
Strawberries	4 heaping tablespoons	100	1.00	0.60	7.40	40
Watermelon	Large slice	300	0.60	0.30	8.10	39
Apricots, dried	10 large	80	3.76	0.80	50.00	228
Dates	10 large	83	1.58	2.08	58.60	266
Figs	10 large	117	8.38	0.58	592.8	633
Prunes	10 very large	200	3.60	....	124.40	525
Raisins	10 very large	25	0.57	0.75	17.13	80
Apple, baked	1 large	120	0.61	0.58	29.30	128
Apple, sauce	3 heaping tablespoons	125	0.25	1.00	46.50	201
Cranberries, stewed	2 heaping tablespoons	100	0.27	0.41	36.00	153
Currant jelly	1 heaping tablespoon	35	0.36	....	27.16	113
Marmalade, orange	1 heaping tablespoon	30	0.18	0.03	25.35	105
Rhubarb, stewed	2 heaping tablespoons	90	0.40	0.47	32.40	139
Graham bread	1 slice	37	3.29	0.67	19.28	99
Biscuits, home-made	1 biscuit	35	3.05	0.91	19.36	100
Biscuits, soda	1 biscuit	38	3.53	5.21	19.99	145
Rolls, French	1 roll	39	3.32	0.98	21.72	112
Whole wheat	1 slice	42	4.07	0.38	20.87	106
Zwieback	1 slice	15	1.47	1.49	11.03	65
Boston cracker (split)	1 cracker	10	1.10	0.85	7.11	42
Graham cracker	1 cracker	8	0.80	0.75	5.9	34
Oyster cracker	10 crackers	11	1.24	1.16	7.76	48
Pretzels	1 pretzel	6	0.58	0.23	4.37	22
Educators, soda cracker	1 cracker	3	0.97	....	1.39	10
Uneeda biscuits	1 cracker	6	0.59	0.55	4.38	25
Chicken sandwiches	1 sandwich	70	8.61	3.78	22.47	163
Egg sandwich	1 sandwich	100	9.60	12.70	34.50	299
Ham sandwich	1 sandwich	70	7.28	10.07	26.65	233
Cream toast Ingredients: 2 slices toast 5 tablespoons cream sauce.	2 slices	136	9.03	14.60	37.15	325

COMMON FOOD VALUES—(*Continued*)

Foodstuffs	Quantity	Weight, grams	Protein, grams	Fats, grams	Carbohydrates	Total calories
ts..................	5 heaping tablespoons	65	7.78	0.40	51.51	247
l mush.............	4 heaping tablespoons	115	3.85	4.11	9.52	93
ents: espoons white corn- 2 cups milk.						
, boiled..............	2 heaping tablespoons	100	2.20	0.20	17.80	84
neal mush...........	3 heaping tablespoons	115	2.10	1.18	18.50	96
i, boiled............	2 heaping tablespoons	100	3.00	1.50	15.80	91
i, baked with cheese	2 heaping tablespoons	140	19.06	20.46	43.44	447
, boiled............	2 heaping tablespoons	100	2.80	0.50	11.50	63
ice..................	5 heaping tablespoons	14	0.87	0.08	12.00	54
iled..................	1 heaping tablespoon	100	2.80	0.10	24.40	112
l wheat biscuit.......	1 biscuit	29	3.05	0.41	22.59	109
i, baked with tomato	3 heaping tablespoons	145	4.52	2.81	25.76	150
e....................	1/6 pie	126	3.91	12.35	53.93	352
pie..................	1/6 pie	133	5.59	8.38	34.71	243
ie....................	1/6 pie	110	3.96	11.11	41.14	288
e.....................	1/6 pie	113	6.55	13.90	43.05	333
ie.....................	1/6 pie	133	5.85	11.17	28.86	246

COMMON FOOD VALUES—(*Continued*)

Foodstuffs	Quantity	Weight, grams	Protein, grams	Fats, grams	Carbohydrates	Total calories
Blanc mange................	2 heaping tablespoons	90	4.76	4.91	16.83	134
Ingredients: 1 heaping tablespoon corn starch, 1 heaping tablespoon sugar, 1 egg, 1 cup milk, 1 tablespoon sherry.						
Doughnuts.................	1 doughnut	37	2.48	7.77	19.65	163
Egg soufflé..................	1/2 soufflé	50	5.22	4.09	38.09	216
Ingredients: 2 eggs, 1/2 cup sugar, 1 tablespoon lemon juice.						
Ice cream..................	2 heaping tablespoons	100	5.21	10.16	17.73	189
Ingredients: 3 cups milk, 1 cup cream, 3 eggs, 2/3 cup sugar, vanilla.						
Ladyfingers................	1	20	1.76	1.00	14.12	74
Macaroons.................	1	10	0.65	1.52	6.52	44
Orange ice.................	2 heaping tablespoons	100	0.94	0.23	74.68	312
Ingredients: 2 1/2 cups orange juice, 1/4 cup lemon juice, 1 1/2 cups sugar, 1 cup water, rind 2 oranges.						
Prune soufflé...............	2 heaping tablespoons	85	3.31	0.65	18.95	97
Ingredients: 1/2 cup stewed prunes (edible portion), white 1 egg.						
French dressing.............	1 dessertspoon	11	....	8.00	....	74
Ingredients: 4 tablespoons olive oil, 1 tablespoon vinegar, 1/4 teaspoon salt, pepper.						
Mayonnaise dressing.........	1 tablespoon	21	0.26	19.92	0.05	187
Ingredients: 2 eggs, 2 cups olive oil, 1 tablespoon vinegar or 1 tablespoon lemon juice, salt, pepper, mustard.						
Cube sugar.................	1 cube	7	......	....	7.00	29
Domino sugar...............	1 domino	6	......	....	6.00	25
Granulated sugar............	1 heaping teaspoon	10	......	....	10.00	41
Powdered sugar.............	1 heaping teaspoon	12	......	....	12.00	49
Maple sugar................	1 cake	100	......	....	82.80	339
Almonds...................	10 large	15	3.15	8.23	2.60	100
Brazil nuts................	10 large	60	10.20	40.08	4.20	432
Chestnuts, roasted as purchased..................	20 nuts	50	2.60	2.25	17.70	104
Coconut...................	1 slice	34	1.94	17.20	9.49	207
Filberts....................	10 nuts	10	1.56	6.53	1.30	72
Peanuts, as purchased.......	15 nuts	30	5.85	8.73	5.55	128

COMMON FOOD VALUES—(*Continued*)

Foodstuffs	Quantity	Weight, grams	Protein, grams	Fats, grams	Carbohydrates	Total calories
	10 large	30	3.30	21.36	3.99	229
s	10 large	42	7.73	27.05	5.46	306
 ients: ping teaspoon cocoa, 1 ng teaspoon sugar, 3/4 ilk, 1 tablespoon cream.	1 cup	227	9.08	15.53	23.85	279
r tea ients: up milk, 1 tablespoon , 2 cubès sugar, coffee .	1 cup	246	2.80	7.64	17.83	156
 ients: , 1 heaping tablespoon , 3/4 cup milk, 1 table- sherry.	1 glass	270	13.00	12.85	29.50	294

SECTION IV

Classification of Foods According to Total Nutrients

The following classification of foods by Elizabeth C. Sprague[1] will be found convenient for those who wish to understand which foods are nitrogenous, which principally starch, which represent fats, etc.

Kind of food as purchased	Total nutrients	Principal nutrient	
		Kind	Am't
1. Total nutrients less than 10 per cent.	Per cent.		Per cent.
A.—Principal nutrient carbohydrates			
Cucumbers	3.9	Carbohyd's	2.6
Celery	4.4	"	2.6
Lettuce	4.5	"	2.5
Tomatoes	5.7	"	3.9
Cabbage	7.3	"	4.8
Asparagus	6.0	"	3.3
Oatmeal gruel	8.4	"	6.3
Peaches	8.7	"	7.7
Buttermilk	9.0	"	4.8
Strawberries	9.1	"	7.0
Corn (green)	9.6	"	7.7
Oranges	9.6	"	8.5
Beets	10.0	"	7.7
B.—Principal nutrient protein			
Beef juice	7.0	Protein	4.9
Codfish (fresh)	8.8	"	8.4
Perch	9.1	"	7.3
2. Total nutrients 10 to 20 per cent.			
A.—Principal nutrient carbohydrates			
Apples	11.7	Carbohyd's	10.8
Milk	13.0	"	5.0
Peas (green)	14.2	"	9.8
Bananas	16.1	"	14.3
Cherries	18.2	"	15.9
Potatoes	17.4	"	14.7
B.—Principal nutrient protein	Per cent.		Per cent.
Veal shank (hind)	10.3	Protein	8.0
Oysters	11.7	"	6.0
Beef shank (hind)	13.6	"	9.7
Chicken (broilers)	14.7	"	12.8
Mackerel (fresh)	14.9	"	10.2
Lake trout	14.9	"	9.1
Veal shank (fore)	15.5	"	12.2
Beef shank (fore)	18.5	"	13.2
Veal neck	18.6	"	13.9
3. Total nutrients 20 to 30 per cent.			
A.—Principal nutrient carbohydrates			
Potatoes (sweet)	24.8	Carbohyd's	21.9
Peas (edible portion)	25.4	"	16.9
B.—Principal nutrient protein			
Beef tongue	21.7	Protein	14.1
Veal chuck	21.2	"	16.0
Veal rib	22.7	"	15.2
Eggs	23.3	"	11.9
Beef neck	23.5	"	14.2
Veal breast	24.2	"	15.3
Veal loin	24.8	"	16.1
Veal leg	24.9	"	18.3
Beef liver	27.1	"	20.2
Beef chuck rib	27.1	"	15.3
Chicken (fowls)	27.0	"	13.7
Chicken cheese	28.0	"	20.9
Beef, round	29.0	"	19.2
Canned salmon	29.0	"	19.5

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[1] Bulletin No. 8, Illinois Farmers, Institute, 1906.

d of food as purchased	Total nutrients	Principal nutrient		Kind of food as purchased	Total nutrients	Principal nutrient	
		Kind	Am't			Kind	Am't
otal nutrients 40 per cent.	Per-cent.		Per-cent.	6. Total nutrients 50 to 100 per cent.	Per-cent.		Per-cent.
incipal nutrient protein				*A.—Principal nutrient carbohydrates*			
leg..........	30.4	Protein	15.4				
enderloin......	33.5	"	18.9	White bread.........	64.7	Carbohyd's	53.1
rloin..........	33.2	"	16.5	Prunes [dried]........	66.0	"	62.2
in.............	33.8	"	16.4	Apricots.............	70.6	"	62.5
orterhouse.....	34.9	"	16.2	Molasses............	74.9	"	69.3
lt)...........	34.9	"	19.0	Dates...............	76.2	"	70.6
, roll.........	35.2	"	19.4	Honey...............	81.8	"	81.2
nk...........	38.4	"	18.6	Beans (dried)........	87.4	"	59.6
incipal nutrient fat				Corn meal...........	87.5	"	75.4
				Rice................	87.7	"	79.0
				Wheat flour..........	88.0	"	75.1
shoulder.....	31.1	Fat	17.1	Macaroni............	89.7	"	74.1
mp...........	34.1	"	18.6	Hominy.............	88.2	"	79.0
....	34.6	"	20.0	Tapioca.............	88.6	"	88.0
....	34.9	"	18.4	Lima beans (dried)...	89.6	"	65.9

SECTION V

Digestibility of Meat

The digestibility of Protein Foods has been already discussed (p. 347). The following table, compiled by N. S. Davis,[1] gives an idea of the time required to digest different kinds of meat in the stomach. The gastric digestion of proteins is not at present considered as important as formerly supposed, but it no doubt facilitates their more complete digestion in the intestine.

DIGESTIBILITY OF MEAT

	Pensoldt	Jessen	Richert	Beaumont
Boiled milk	1 to 2 hrs. 100 to 200 grams			
Bouillon	" " 200 "			
Eggs, raw	" " 100 "		2 to 3 hrs.	1 1/2 hrs.
Milk	" "		30 to 60 min.	2 "
Pigs' feet	" "		1 hr.	
Trout	" "			1 1/2 "
Calf's brains, boiled	" "			1 3/4 "
Boiled milk	2 to 3 hrs. 300 to 500 grams			
Eggs, hard boiled or omelet	" " 100 "			
Beef sausage, raw	" " 100 "			
Brains, boiled	" " 250 "			
Sweetbread	" " 250 "			
Oyster, raw	" " 72 "			
Carp, boiled	" " 200 "			
Pike, boiled	" " 200 "			
Sharper, boiled	" " 200 "			
Beef, raw, chopped fine		2 hrs.		
Beef, half cooked		2 1/2 hrs		
Beef, well cooked		3 "		
Beef, thoroughly roasted	3 to 4 hrs. 100 grams	4 "		
Mutton, raw		2 "		
Veal, cooked	" " 100 "	2 1/2 "		
Pork, cooked		3 "		
Mutton, roasted				3 hrs.
Beefsteak				3 "
Ham, cooked	" " 160 "			3 "
Fain beef, broiled				3 "
Lesh, boiled				3 "
Bacon, roasted				4 "
Poultry				4 "
Veal				4 "
Codfish, boiled	2 to 3 hrs. 200 grams			
Chicken, young, boiled	3 to 4 " 230 "			

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[1] Food in Health and Disease, p. 99.

DIGESTIBILITY OF MEAT—(*Continued*)

	Penzoldt	Jessen	Richert	Beaumont
e, roasted	3 to 4 hrs. 230 grams			
boiled	" " 250 "			
oked	" " 250 "			
ot, boiled	" " 250 "			
w	" " 160 "			
k, raw, grated	" " 100 "			
boiled	" " 100 "			
	" " 72 "			
pickled and smoked	" " 200 "			
oasted	4 to 5 hrs. 210 "			
beef, roasted	" " 250 "			
gue, smoked	" " 250 "			
	" " 100 "			
asted	" " 250 "			
e, roasted	" " 240 "			
oasted	" " 250 "			
oasted	" " 280 "			

SECTION VI

Some American Commercial Food Products

Badex, a mixture used by bakers as a substitute for wheat flour.
Carolone, skimmed milk and nut oil.
Cottolene, cottosuet, a compound lard containing cottonseed oil and lard.
Covo, a lard vegetable cooking oil, made principally from corn oil.
Crisco, a hydrogenated vegetable fat, used as a lard substitute.
Douglas oil, a refined corn oil.
Drinkit, a cereal coffee substitute.
Enzo, a milk product with vegetable fats.
Excello, a cake preparation, of flour, sugar, shortening, milk, etc., ready to be mixed with water and baked.
Gem Nut Margarine, a butter substitute, made from cocoanut oil, peanut oil and milk.
George Washington Coffee, an evaporated coffee extract.
Hebe, a compound of vegetable fats and skimmed milk.
Hipolite, cocoanut oil and gelatin.
Jelly Powders, gelatin mixed with sugar and flavor.
Jello, gelatin, sugar and flavor.
Jiffy Jell, gelatin, sugar and flavor, sometimes with coloring material.
Junket Tablets, used to coagulate milk for desserts.
Kafir Tea, a tea substitute.
Karo, a glucose or corn sirup.
Klim, powdered, dry, whole milk.
Krystalak, dried skim milk.
Log Cabin Sirup, cane and maple sugar.
Magnolia Oil, a peanut oil, for salads.
Malted nuts, a coffee substitute.
Marcella Oil, a peanut oil for salads.
Mazola, a purified corn oil for salads.
Minute Brew, a cereal coffee substitute.
Nucoa, a butter substitute made from cocoanut oil.
Nutola, a vegetable fat used as a butter substitute.
Ovaltine, a concentrated extract from malt, milk and eggs, flavored with cocoa. Prepared as egg malted milk.
Pancake Flours, mixtures of flour, baking powder, salt etc., to be mixed with water for making cakes.
Postum, a cereal coffee substitute.
Postum, (Instant), wheat products, with small quantity of molasses.
Ry-al-fa, a sirup, containing corn sirup, cane sugar and alfalfa extract.
Ryzon, a mono-sodium-phosphate baking powder.
Snowdrift, a cottonseed oil, lard product.
Stereo, cubes used for the preparation of bouillon.
Troco, a cocoanut oil margarine.
Vitalait, a Bulgarian bacillus, for making a milk beverage.
Wesson Oil, a purified cotton seed oil, for salads.
Yogurt, Bulgarian bacillus tablets.

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